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KUNGL. SVENSKA VETENSKAPSAKADEMIENS HANDLINGAR
TREDJE SERIEN. BAND 15. N:O 3.

ADDITIONAL CRETACEOUS PLANTS FROM WESTERN GREENLAND

BY

A. C. SEWARD AND VERONA CONWAY

WITH 6 PLATES AND 32 FIGURES IN THE TEXT

READ OCTOBER 9th 1935

Nachlaß von Prof. N. Malta

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Additional Cretaceous Plants from Western Greenland.

Prefatory Note.

The fossils described in the following pages were selected from a large collection sent to me several years ago from Stockholm and Copenhagen: many of them are from the Swedish Museum of Natural History, Stockholm and some are from the Mineralogical and Geological Museum, Copenhagen. I am greatly indebted to Professor HALLE and Professor BÖGGILD for the loan of the specimens. A description of fossil plants from beds of a later age by Miss CONWAY and myself is being published in the *Meddelelser om Grønland.*[1]

In the preliminary examination of the material much assistance was received from Mr F. W. SHOTTON, now Lecturer in Geology in the University of Birmingham, who devoted a considerable amount of time to the difficult task of naming the dicotyledonous leaves; Mr J. S. L. GILMOUR, now Assistant Director of the Royal Gardens, Kew, gave me much valuable help, also Mr T. G. TUTIN of Downing College. I take this opportunity of thanking these three friends.

The specimens which we thought worthy of illustration and description were chosen from a very large number submitted to me for examination; they enable us to supplement the contributions to the Greenland Cretaceous flora made by myself ten years ago. There is, however, still much to be done before we can fully appreciate the richness and significance of the Cretaceous and Tertiary floras of Greenland: we lack precise data on the localities from which many of the fossils were obtained, and further information on the stratigraphical relationship of the various plant-bearing beds is urgently needed. The majority of the Stockholm plants were collected by the late Professor NATHORST many years ago: to him I owe much, and it is a pleasure to be able to record my indebtedness to Professor HALLE, his successor, and to Dr FLORIN. Some of the specimens are from the Copenhagen Museum and were collected several years ago by Dr HARTZ. Figured specimens from Copenhagen are indicated by the letter K.

[1] Bd. 93, Nr. 5, 1935.

A. C. SEWARD.

Description of the Specimens.

Equisetales.

Equisetites amissus (Heer). Pl. I, fig. 4 (× 4); Pl. II, fig. 10 (nat. size).

In 1874 Heer[1] described as *Equisetum amissum* specimens from several localities and from beds assigned by him to the Kome, Atane and Patoot series, which he regarded as rhizomes. One of us[2], after examining Heer's specimens, expressed the opinion that no undoubted examples of the genus had been found in the Cretaceous rocks of Greenland. The examination of additional and better specimens has afforded proof of the occurrence of Equisetaceous rhizomes, tubers, and leaf-sheaths, and it is probable that the 'Rhizome bed', previously recorded[3] from several Cretaceous localities, is to a large extent the surface-soil in which stems of *Equisetites* were preserved.

Part of a slab of burnt, red shale from Patut (Pl. II, fig. 10) illustrates the form and surface-features of some of the numerous flattened rhizomes which monopolize the rock; they are identical with specimens previously figured by one of us as *Rhizomata*[4] and, probably, with some of Heer's examples of *Equisetum amissum.* The rhizomes are occasionally branched and characterized by an irregular longitudinal ribbing due, possibly, to the collapse of the cortex above vallecular canals. Nodal lines are clearly shown in some examples (Pl. I, fig. 4) at intervals of 3—5 cm., but there are no leaf-sheaths on the rhizomes. These Equisetaceous remains are among the very few fossil plants which form a link between the past and the present Arctic vegetation. As a whole the Cretaceous and Tertiary floras afford a striking contrast to the stunted shrubs and herbaceous plants which we now associate with northern Greenland. A list of species described, with localities, is given on page 33.

Patut.

Equisetites sp. Diaphragm. Pl. I, fig. 2 (× 3).

We found a single nodal diaphragm among the fossils collected by Dr N. Hartz of Copenhagen at Atanikerdluk, but the precise horizon is not known. From the edge of the disk, 1 cm. in diameter, a number of slender arms radiate outwards, and these are no doubt portions of a leaf-sheath. The specimen resembles a diaphragm figured by Heer from the Kome series at Avkrusak as *Equisetum annularioides.*[5]

Atanikerdluk.

[1] Heer (74), p. 60, Pls. XIII, 2—8; XXII, 11. See also Seward (25), p. 232.
[2] Seward (26), p. 68.
[3] *Ibid.*, p. 62.
[4] Seward (25), Pl. A, 1—2 A.
[5] Heer (74), p. 61, Pl. XIII, 6. See also Seward (25), p. 233.

Equisetites sp. Tuber. Pl. I, fig. 1 (× 2).

This specimen consists of an axis 0.5 cm. in width bearing a relatively large, shrunken, and obovate tuber 3.5 cm. long.

Atanikerdluk.

Filicales.

Gleicheniaceae.

Gleichenites Gieseckiana HEER.[1] Pl. II, fig. 9 (nat. size).

The specimen shown in fig. 9 is much larger than any which were available when this species was discussed in 1926[1]: at that time, after some hesitation, the specific name was used in a wide sense and applied to pinnae bearing both straight and curved pinnules. Though in the absence of well preserved fertile examples it is impossible satisfactorily to determine specific differences, we are now inclined to think that the curvature of the pinnules — a character clearly shown in HEER's type[2] from Kuk, the locality from which our specimen was obtained — may be a specific peculiarity; if this supposition is correct, the synonymy previously given is too comprehensive. The pinnae reach a length of 10 cm.: the pinnules may be nearly 1 cm. long and the lamina usually tapers gradually from the base in contrast to the more parallel-sided of *G. Nordenskiöldi* HEER.

In venation and general habit and in the curved rachis the specimen agrees with others previously described. None of the specimens which we have seen in the present collection from Kuk are fertile.

Kuk.

Gleichenites Nordenskiöldi HEER.[3] Pl. I, fig. 6 (nat. size); Pl. I, fig. 8 (× 4).

Several examples believed to belong to this species occur in the burnt shale from Patut, a locality from which it has not been hitherto recorded, also in the black shale of Atanikerdluk and at Kuk. On a piece of fertile pinna (Pl. I, fig. 8) the pinnules bear numerous sori, 6—7 on a single pinnule: there are 4—7 sporangia in a sorus.

Patut, Atanikerdluk, Kuk.

Gleichenites Porsildi SEWARD. Pl. I, fig. 5 (× 4).

Pieces of sterile pinnae on a ferruginous sandstone afford evidence for the first time of the occurrence of this species at Atanikerdluk. The pinnules are 1.2 cm. long and tapered: the acute angle made by the lateral veins is a marked feature of this form.[4] Bifurcate axes occur in association with the pinnae.

Atanikerdluk.

[1] SEWARD (26), p. 69.

[2] HEER (68), p. 78, Pls. XLIII, XLIV.

[3] For description and synonymy, see SEWARD (26), p. 74.

[4] SEWARD (26), p. 76.

Gleicheniopsis fecunda (HEER) TUTIN.
Gleicheniopsis Sewardi TUTIN.
Gleicheniopsis sp. = **Gleichenites Gieseckiana** (HEER) SEWARD **ex parte.**

The generic name *Gleicheniopsis* was instituted by Mr T. G. TUTIN[1] for certain Gleicheniaceous fossils which he found in the collection of Dr HARTZ submitted to the senior author for examination. The species are based on pinnae with small pinnules having large, crowded sori with 10—40 sporangia. The spores are large, about 32 in each sporangium. *Gleicheniopsis fecunda* is from Patut and Ritenbenk's coal mine; *G. Sewardi* from Pagtorfik and Kaersuarssuk. *Gleicheniopsis* sp. is based on a piece of a small fern previously figured[2]; it may be *G. fecunda.* It is clear, as TUTIN says, that the Gleicheniaceae had a greater range in the structure of the sporangia in the Cretaceous period than they have at the present time.

Dipteridinae.

Hausmannia Dicksoni (HEER). Pl. I, fig. 7 (nat. size).
?Hausmannia Kohlmanni RICHTER (06), Pl. I, figs. 1—3.

This specimen, imperfectly preserved on a piece of dark grey shale, is, we think, specifically identical with one described by HEER[3] from Ikorfat as *Dictyophyllum Dicksoni*, which was transferred by one of us[4] to *Hausmannia.* Though too small to be assigned with confidence to a species, it is worth recording as additional evidence of the existence of the genus in the Greenland flora. *Hausmannia* had a fairly wide distribution in Europe in the earlier part of the Cretaceous period[5]; its modern representative (*Dipteris*) is confined to the Malayan-Indian region.

Atanikerdluk.

Matonineae.

Laccopteris latifolia (NATH.) SEWARD. Pl. I, fig. 3 (× 4).

The incomplete, fertile pinnule, 1 cm. broad, shown in fig. 3 agrees very closely with a specimen figured by NATHORST[6]: the circular sori are clearly seen and in some there is a small central depression. Faint traces of radial markings like those reproduced in NATHORST's illustrations were detected. Reasons for preferring the generic name *Laccopteris* to *Nathorstia* have already been given.[7]

Atanikerdluk.

[1] TUTIN (32).
[2] SEWARD (26), Pl. V, 12, 12 A; text-fig. 20.
[3] HEER (74), Pl. III, 9.
[4] SEWARD (25), p. 234.
[5] SEWARD (13), p. 89; LIPPS (23).
[6] NATHORST (08), Pl. III, 64.
[7] SEWARD (25), p. 237.

Filicales incertae sedis.

Sphenopteris groenlandica (Heer) **ex parte.** Pl. IV, fig. 17 (nat. size).

The specimen reproduced in fig. 17 bears a close resemblance to several fossils described as ferns from Cretaceous rocks in North America and Greenland: unfortunately the venation is not preserved with the exception of a faint indication of a midrib in a few of the pinnules. The pinnules are long and narrow, tapering to an acute apex; they appear to be entire. It is probably specifically identical with some of the fossils included by Heer[1] in his *Dicksonia groenlandica*, *e. g.* from Igdlokunguak and Patut; it differs in the entire margins of the pinnules from other examples of the species. It agrees very closely with *D. groenlandica* as figured by Berry[2] from the Cenomanian plant-beds at Woodbridge, New Jersey. Another example of the same form of frond is represented by one of the specimens referred by Heer to *Aspidium Oerstedi.*[3] Ferns of very similar habit have been described as species of *Anemia* and of *Onychiopsis.*[4] It would be rash to attempt a reference of this frond to any family or recent genus.

It is perhaps not impossible that this fossil may be a compound leaf of a Dicotyledon: the impression suggests a plant with leaves of leathery texture very similar in form to the foliage of *Grevillea robusta*, the well known Australian Proteaceous species. We do not presume to regard this comparison as more than a possibility; but while recognizing the fact that many fronds of similar, though not identical form, are undoubtedly ferns, and some that are fertile resemble *Onychiopsis*, we are not convinced that the suggested possibility of a dicotyledonous affinity is extravagant or unreasonable.

Patut.

Sphenopteris (Onychiopsis?) Johnstrupi Heer.

An imperfect specimen from Kuk is probably specifically identical with Heer's species and though it is not well enough preserved to be determined with certainty it may be compared with a piece of frond previously figured[5] from Kugssinek Angnertunek.

Kuk.

Sphenopteris sp. Cf. **Coniopteris.** Text-fig. 1 (× 2).

The figure represents part of an imperfectly preserved specimen with two fertile pinnae 3.5 cm. long, on each of which are about twelve pinnules. The pinnules bear sori on the distal and anterior margins: no sporangia were obtained by special treatment, only two spores. Our specimen is similar to *Stachypteris inenarrabilis*[6] Holl. from the Upper Cretaceous of Alaska.

Igdlokunguak.

Text-fig. 1. *Sphenopteris* sp., × 2.

[1] Heer (82), Pl. XXXV, 8; (82), Pl. XLVIII, 3.
[2] Berry (11[2]), Pl. IV. See also Newberry (95), Pl. III, 1.
[3] Heer (82), Pl. XXXIV, 8.
[4] Berry (11), p. 33.
[5] Seward (26), Pl. VII, 33.
[6] Hollick (30), Pl. I, 9.

Cladophlebis frigida (HEER) var. **longipennis** (HEER).
Pteris longipennis HEER (82), Pls. X, XIII.
Cladophlebis frigida var. *longipennis* SEWARD (26), p. 87.

Good examples of this fern from Atanikerdluk show the characters previously described by HEER: the longest pinnules attain a length 4.3 cm. The specimens described by HEER from Puilasok as *Pteris argute-nervis* and *P. groenlandica*[1] should, we think, be referred to *Cladophlebis frigida*. HEER's *Asplenium puilasokense* is probably *Sphenopteris* (*Onychiopsis*) *psilotoides* St. and Webb.[2]; his *Cissites puilasokensis*[3] is no doubt a *Platanophyllum*, and his *Myrsine consobrina*[4] may be *Dalbergites simplex* (NEWB.) or *D. borealis* (HEER). The Puilasok plants seem to indicate a Cretaceous age and are not, as HEER supposed, Tertiary. As Mr SHOTTON pointed out in his notes on the present collection, some of the fossils figured by HEER[5] from Atanikerdluk and Ivnanguit as *Pteris Albertsii* DUNK. are almost certainly *Cladophlebis frigida*.

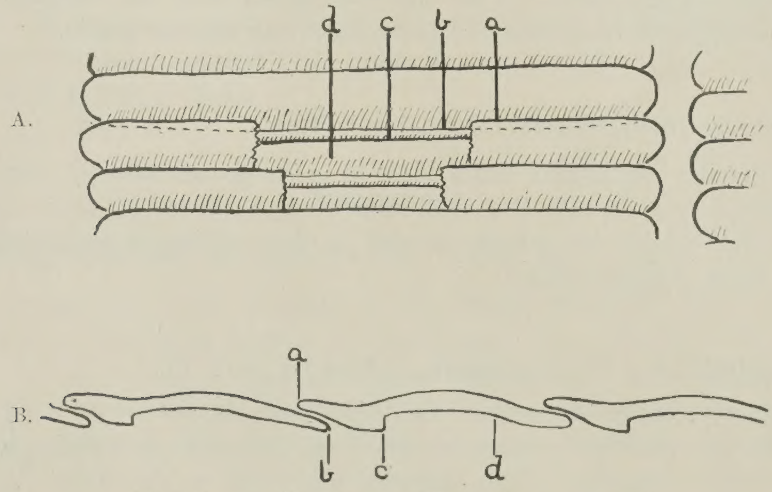
Atanikerdluk.

Cycadophyta.

Bennettitales.

Pseudocycas Thomasi sp. nov. Pl. III, figs. 13 (*ca.* × 2) and 16 (very slightly enlarged). Text-figures 2—4.

The specimens from Upernivik Naes on which this species is founded bear some resemblance to *Cycas Dicksoni* HEER and *Zamites acutipennis* HEER,

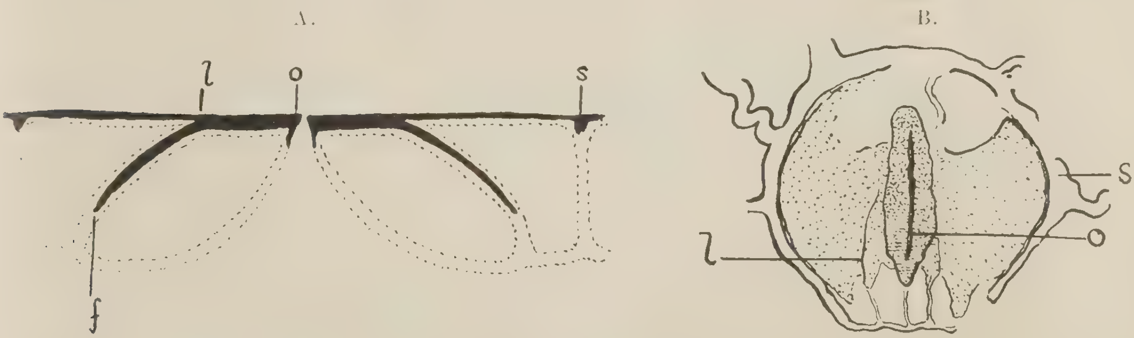


Text-fig. 2. *Pseudocycas Thomasi* sp. nov. K.
A. Diagrammatic surface-view; B. Diagrammatic section of pinnae (V.C.)
a, anterior edge of pinna; *b*, posterior edge of the next pinna; *c*, ridge at anterior limit of stomatal band; *d*, posterior limit.

[1] HEER (83), Pl. CVII, 1, 2.
[2] *Ibid.*, Pl. CVII, 4; SEWARD (26), p. 83.
[3] *Ibid.*, Pl. CVII, 8—10.
[4] *Ibid.*, Pl. CVII, 11; SEWARD (26), p. 135.
[5] HEER (82), Pl. XVI, 6; XLVI, 22—24.

but we regard them as worthy of specific rank and name the species after Dr Hamshaw Thomas. The pinnae are in close contact with one another laterally (figs. 13 and 16); they are 1 mm. broad and 2 cm. long and are attached to the rachis at a wide angle; the apices are obtuse and the bases slightly rounded. They cover almost the whole breadth of the rachis. In fig. 13, Pl. III, the rachis, 5 mm. broad, is exposed by the breaking away of the bases of the pinnae; in fig. 16 the pinnae are intact and cover almost the whole of the rachis. The relation of the pinnae to one another is shown in text-fig. 2; the pinnae are shortened for convenience. In text-fig. 2 A, which is a diagrammatic surface-view, the anterior and posterior edges are shown at *a* and *b* respectively: *c* is the ridge at the anterior limit of the stomatal band, and *d* marks the posterior limit. Text-fig. 2 B, drawn to a different scale, is a transverse section: the stomata occupy a well-defined band on the lower surface between *c* and *d*. The boundary of the stomatal strip at *d* is fairly well defined in preparations of the cuticle, but at *c* there is an angular boundary which is seen on the cuticle as a very dark band often associated with a considerable amount of débris. The cuticle on the upper surface is of medium thickness: the cell-walls are sinuous (text-fig. 3) on both surfaces of the pinnae. The stomata are of the Bennettitalean type, numerous and irregularly orientated and level with the surface; the cuticle bounding the aperture is thick; the subsidiary cells are crescentic. Text-fig. 4 A is a reconstruction of a transverse section of a stoma: the cuticular thickening is shown as black lines and the dotted lines represent imaginary cell-walls. Text-fig. 4 B shows a stoma in surface-view on the lower surface of a pinna: the characteristic cuticular thickening of the guard-cells

Text-fig. 3. *Pseudocycas Thomasi.* Cells of upper surface of pinna. ×675. The walls are stippled. (V.C.) K.



Text-fig. 4. *Pseudocycas Thomasi.* K.

A. Diagrammatic section of a stoma; cuticular thickenings black; dotted lines=imaginary cell-walls. B. Stoma, ×900.

l, line of junction of guard-cell and subsidiary cell; *o*, outer end of aperture-tube; *f*, free margin of dorsal thickening of guard-cell; *s*, wall of subsidiary cell. (V.C.)

is stippled; *l* is the line of junction of guard-cell and subsidiary cell; *o* is outer wall of the aperture and *s* is the wall of the subsidiary cell.

In species of *Pseudocycas* previously described[1] the stomatal band is bounded on both sides by a definite ridge and is much narrower than in *P. Thomasi*, where it is half as broad as the pinna. Our species bears a strong resemblance to *P. Dunkeriana* (GÖPP.) as described by FLORIN.[2] The two species agree in the breadth of the segments, the mode of their attachment to the rachis, and in the arrangement and orientation of the stomata. They differ in the following characters: *P. Dunkeriana* has much wider fronds, up to 8 cm.; its pinnae are curved upwards, and the upper surface bears hairs and papillae. These differences alone might not be sufficient to separate the species: a more important point is that in *P. Thomasi* the dorsal walls of the guard cells are most strongly cutinised nearest the pore, *i. e.* proximally, hence the stomata do not show a lighter median area, as seen in FLORIN's text-fig. 1 and Pl. XV, figs. 3 and 7, which is due to the proximal region being thinner than the rest.

It must, however, be admitted that the preservation of the cuticle in our preparations is poor; possibly if better material were available a different conclusion might be reached. Provisionally at least it seems better to retain both specific names.

Upernivik Naes.

Pseudocycas Steenstrupi (HEER) NATHORST.[3]

A single specimen from Upernivik Naes agrees very closely with those from other localities: a preparation of the imperfectly preserved cuticle showed sinuous walls and stomata identical with those described by NATHORST.

Upernivik Naes.

Pterophyllum Harrisi sp. nov. Pl. II, fig. 11 (×1 ½); Pl. III, figs. 12, 15 (×1 ½); text-figs. 5—10.

Text-fig. 5. *Pterophyllum Harrisi* sp. nov. Pinna, ×3. (V.C.) K.

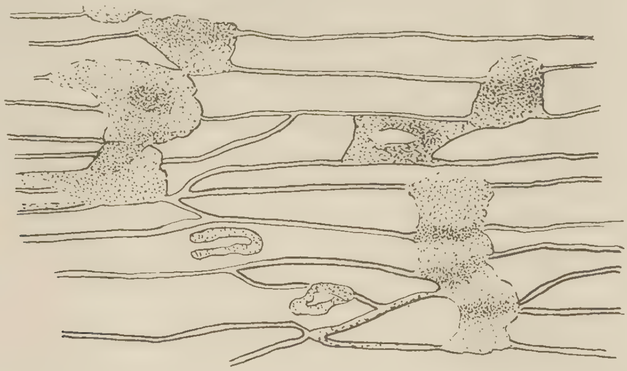
Our examination of the cuticular characters of the specimens reproduced in figs. 11, 12, 15 leads us to regard them as examples of a new species which we name after Professor T. M. HARRIS. In some specimens the rachis is not overlapped by the bases of the pinnae; fig. 11 shows in places the rachis bare of pinnae. We believe that the specimens chosen for illustration are examples of one species. The pinnae reach a length of 2 cm. and vary in breadth from 2 to 5 mm.; they are inclined at an angle of 60°—90°. As seen in the photographs the curvature of the margins is not constant; some are symmetrical and other asym-

[1] NATHORST (07); HOLDEN (14).

[2] FLORIN (33).

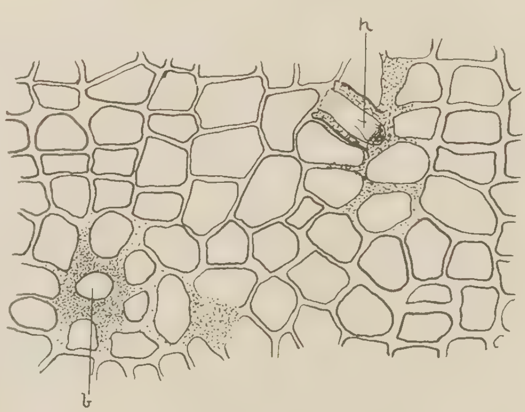
[3] HEER (82), p. 40, Pl. V; NATHORST (07), p. 8, Pls. VIII, XI, 10, 11.

metrical; the apex is obtuse and small teeth are occasionally present as seen in text-fig. 5, which also shows the venation. The epidermal cells of the rachis are elongate and have frequent annular thickenings which we regard as bases of hairs similar to those described in other fronds[1] and seen on the pinna of our species. Text-fig. 6 shows the lower surface of a rachis: the



Text-fig, 6. *Pterophyllum Harrisi.* Cells of lower surface of rachis, ×300. (V.C.) K.

bases of hairs and the thick, discoloured patches associated with them are stippled. No stomata were found on the rachis. The upper surface of the pinnae is very thick; the cells are isodiametric and have straight walls; above the veins the cells are in regular rows; there are no stomata. A base of a hair is seen at *b*, text-fig. 7, and the remains of a hair at *h*. In some places (text-fig. 8) patches of thickening occur in the cells recalling papillae such as are found in *Pterophyllum aequale*[2] and in *P. filicoides*[3] though in our species the dark patches are larger. The lower cuticle of the pinnae is much thinner than the upper; the cells have straight walls, and, except over the veins, they are isodiametric. Stomata occur between the veins and are irregularly orientated: bases of hairs are scattered over the lamina. Text-fig. 9 illustrates the distribution of stomata (black lines) and hairs (circle showing hair-base) on the lower surface of a pinna. The stomata are Bennettitalean and appear to be slightly below the level of the pinna-surface: in a few places it was possible to see the margin of the shallow stomatal depression (text-fig. 10 A). The structure and form of the stomata are shown in text-fig. 10. In text-fig. 10 A the general level of the



Text-fig. 7. *Pterophyllum Harrisi.* Upper surface of pinna: *h*, hair; *b*, hair-base. ×300. (V.C.) K.

[1] THOMAS & BANCROFT (13).

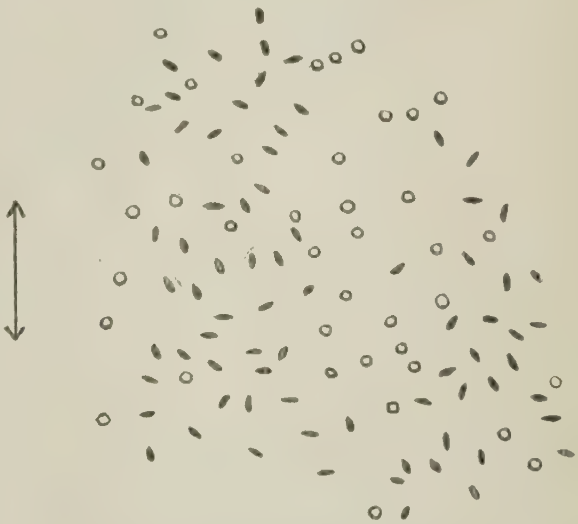
[2] JOHANSSON (22).

[3] THOMAS (30).

Text-fig. 8. *Pterophyllum Harrisi.* K. Upper surface showing papillae. ×300. (V.C.)

pinna is in focus and is shown by thick lines: the guard-cells and subsidiary cells, shown as dotted lines, are out of focus. A broken rim of guard-cell cuticle is seen at *a*; *f* is the free margin of the lateral thickening of a guard-cell; *p* is the rim of the shallow pit in which the stoma lies; *s* is the wall of a subsidiary cell. Other views of stomata are seen in text-fig. 10 B and C: *o* is the outer, and *i* the inner side of the stomatal aperture; *b* (text-fig. B) is a bar of cuticle at the polar ends of the guard-cells (the other letters as in text-fig. 10 A). Text-fig. 10 D is a reconstructed transverse section of a stoma: the cuticular thickenings are black (lettering as in the other figures).

In external features and cuticular characters *Pterophyllum Harrisi* agrees with the genus *Pterophyllum;* it differs, however, in certain features from other species such as those described by THOMAS and BANCROFT[1], HARRIS[2], and JOHANSSON.[3] It resembles *P. aequale* as described by JOHANSSON, but in that species there are no hair-bases. Among Greenland species the nearest is *P. concinnum* HEER[4]; but in *P. Harrisi* the veins are fewer and the pinnae are occasionally dentate; moreover, the cell-walls of HEER's species are strongly sinuous.[5]



Text-fig. 9. *Pterophyllum Harrisi.* K. Distribution of stomata (black) and hair-bases (circles) on lower surface of pinna. ×100. (V.C.) The arrow indicates the long axis of the pinna.

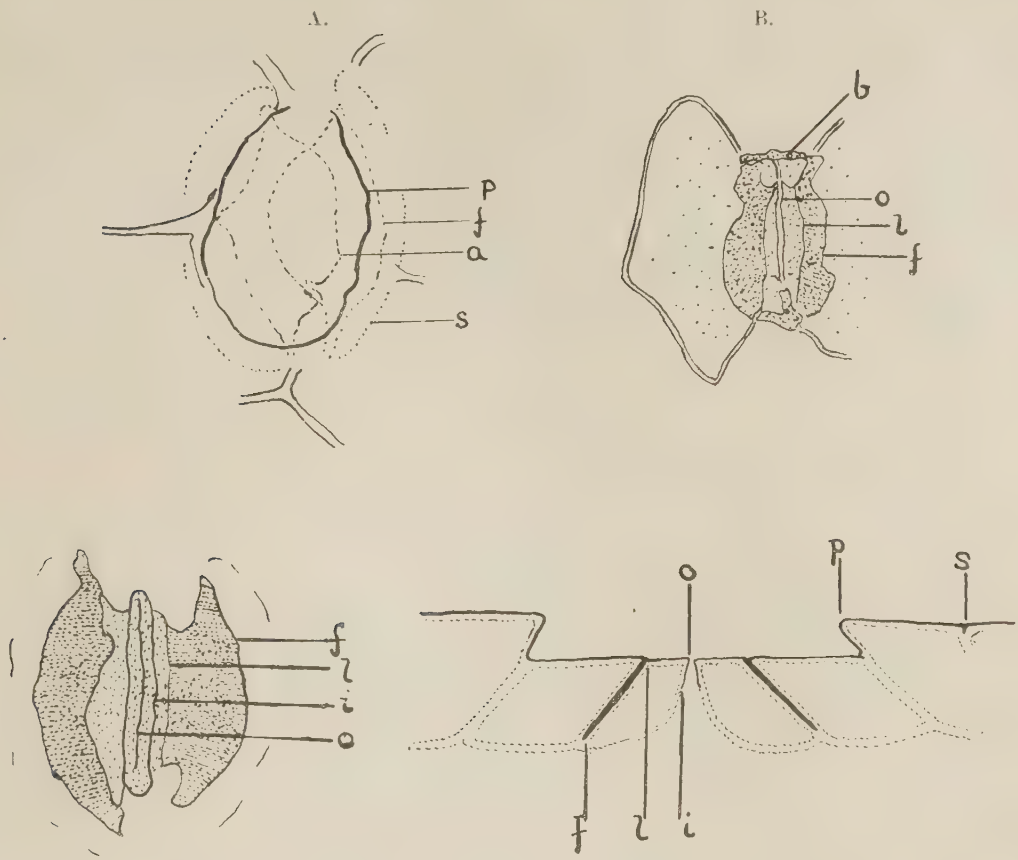
Kardluk and Upernivik Naes.

Non-Bennettitalean Cycadophyta.[6]

Pseudoctenis latipennis (HEER) SEWARD. Pl. III, fig. 14 (×1 ½),

The specimen shown in fig. 14 is part of a pinna 1.5 cm. broad at the base, narrowing gradually and apparently at an angle of 70° to the rachis. There are 25—30 parallel veins and though no anastomoses are clearly seen

[1] THOMAS and BANCROFT (13).
[2] HARRIS (26), (32).
[3] JOHANSSON (22).
[4] HEER (74), Pl. XIV, 15—20.
[5] SEWARD (25), p. 241.
[6] HARRIS (32), p. 86.



Text-fig. 10. *Pterophyllum Harrisi.* K.
A.—C. Surface-views of stomata; D., reconstruction of transverse section. For explanation see text. A. and C., ×900; B., ×600. (V.C.)

we are inclined to think that oblique cross-connexions occur in one or two places. We regard this specimen as specifically identical with HEER's *Podozamites latipennis*[1], but the veins seem to be for the most part at least unbranched. One of the fossils figured by HOLLICK from Alaska as *Podozamites lanceolatus*[2] may be a pinna of *Pseudoctenis*, and possibly identical with the Greenland species. Attention may be drawn to a frond from the Frontier formation of Wyoming of late Upper Cretaceous age named by BERRY *Nilssonia Mehli*[3], which has segments not unlike that shown in fig. 14.

Unartuarssuk.

Palaeanthus tenuistriatus sp. nov. Pl. V, fig. 26 (×1 $^1/_2$).

The specimen reproduced was selected from several in the collection: it is a fan-shaped, thick structure, 3 cm. long and rather broader; a short, thick basal portion expands into a broad and slightly concave portion characterized

[1] SEWARD (25), p. 239.
[2] HOLLICK (30), Pl. VIII, 8.
[3] BERRY (28), Pl. XX.

by numerous, radially disposed, irregular ridges. It bears a resemblance to HEER's *Williamsonia cretacea*[1] from Atanikerdluk, and to *W. problematica* (NEWB.)[2] as figured by HOLLICK, a species originally referred to *Palaeanthus*[3], but in those specimens there are clearly-defined narrow leaves or bracts whereas in our fossils there is usually a continuous and irregularly ridged surface. Possibly this fossil may be a scale of a Bennettitalean flower; though differing in form from a *Cycadospadix* figured by HARRIS[4] from East Greenland it may be morphologically similar. Another fossil which may be comparable in nature is the Jurassic species, *Cloughtonia rugosa* HALLE.[5]

Igdlokunguak.

Ginkgoales.

Ginkgoites pluripartita (SCHIMP.).

A.

Several examples of this species from the black shale of Atanikerdluk afforded additional evidence of the variation in the degree of dissection of the lamina: some are almost entire and others have as many as six lobes. A petiole 5 cm. long was noticed on one of the leaves. Cuticular preparations showed the characters already described.[6]

Atanikerdluk.

B.

Text-fig. 11. *Ginkgoites concinna* HEER. A., epidermal cells; B., stoma. ×300. (F. W. Shotton.)

Ginkgoites concinna HEER. Text-fig. 11.

It is impossible, without any knowledge of the cuticular structure of HEER's Siberian species, confidently to describe the Greenland leaf, which in external characters appears to be indistinguishable from his specimens, as specifically identical with the type-specimens of *Ginkgo concinna*.[7] The specimen from which we obtained preparations of the cuticle is the same as that previously figured by one of us[8] and, still earlier, by NATHORST: it was described as

[1] HEER (82), Pls. XII, 1; XIII, 9.
[2] HOLLICK (06), Pl. V.
[3] NEWBERRY (95), Pl. XXXV.
[4] HARRIS (32[2]), p. 96.
[5] HALLE (11).
[6] SEWARD (26), text-fig. 11.
[7] HEER (76), p. 63, Pls. XIII, 6—8; VII, 8.
[8] SEWARD (26), p. 96, Pl. X, 101.

Baiera sp. *cf. B. Lindleyana* (Schimp.) and it was pointed out that »Heer's *Ginkgo concinna* from the Jurassic flora is another example of the same form of leaf». The Greenland leaf has precisely the same form as one from Alaska assigned by Hollick[1] to *G. concinna*. We now substitute *Ginkgoites* for *Baiera* on the ground that there is a definite petiole, a character adopted by Harris[2] as a distinguishing feature. The epidermal walls are sinuous (text-fig. 11, A) and the stomata are surrounded by six subsidiary cells (text-fig. 11, B). It is clear that a form of *Ginkgoites* leaf persisted from the Jurassic period to the Cretaceous and, if Hollick's estimate of the age of the Alaskan flora is correct, to the Upper Cretaceous: we cannot, however, be sure that the leaves belong to one species.

Atanikerdluk.

Coniferales.

Sequoiineae.

Sequoiites concinna Heer. Pl. IV, figs. 18, 21. (Nat. size.)

The best example of this species in the collection is reproduced in fig. 18; it shows the characteristic features of a vegetative shoot as represented in the figures cited in the following list selected from a large number of records of this common Cretaceous conifer, particularly the disposition of the narrow, acute and often falcate leaves.

Sequoia concinna Heer (83), Pls. L—LIII.
» » Seward (26), Pl. IX, 69, 72, 73, 79, 80.
» » Hollick (30), Pls. XXII, 6—8; XXVII, 1, 2.
Sequoia fastigiata Hollick (30), Pl. XXI, 1—4.

Some of the smaller specimens included by Heer in *S. Reichenbachi* should probably be referred to *S. concinna*, though it would seem reasonable to retain the specific name *Reichenbachi* for such examples as those figured by Heer[3] with broader, longer, and more crowded leaves. It is, however, possible that the two forms of shoot represent different ages and states of one species. The delimitation of sterile coniferous branches is a hopeless task. It is by no means easy, even when imperfect cones are present, to decide between *Sequoia* and *Glyptostrobus* as the more appropriate name.

The material examined by us does not include any very well preserved cones: one of the best is shown in fig. 21: these are portions of two cones made up of broadly triangular and radially ribbed scales attached to leafy shoots.

Ujaragsugssuk.

[1] Hollick (30), Pl. XI, 1.
[2] Harris (31), p. 150.
[3] Heer (74), Pl. XXXVI, 1—8.

?Sequoiineae.

Elatocladus Smittiana (Heer) Seward.[1] Pl. IV, fig. 22 (nat. size).

Heer stated that his Cretaceous species may be distinguished by the unconstricted bases of the two-ranked, parallel-sided leaves from the widespread and very similar conifer, *Sequoiites Langsdorfii*. In many of the published illustrations of the latter species the leaf-bases are continued along the axis of the branch without any constriction, but, on the other hand, leaves with a contracted base — possibly the result of twisting and the manner of preservation — occur in association with leaves with no such constriction. *Elatocladus Smittiana*, as previously stated, differs from *S. Langsdorfii* in its longer and relatively broader leaves, a less prominent midrib, and in its less rigid appearance. Comparison may be made with some of the Alaskan specimens assigned by Hollick[2], on insufficient evidence, to *Cephalotaxopsis*.

Atanikerdluk.

Coniferales incertae sedis.

Cyparissidium gracile Heer. Pl. IV, fig. 19 (nat. size).

The species has already been fully described[3]: the material recently examined throws no additional light on its affinities, but we are able to record it from two new localities. A specimen from Atanikerdluk (fig. 19) illustrates the pinnate habit: the leaves vary in different parts of the shoot; on the finer branches they are rhomboidal, spirally disposed and closely appressed. Preparations of the cuticle, while confirming the previously published account, enable us to add: short glandular hairs two or three times longer than an epidermal cell are scattered irregularly over the surface of the leaves.

Some of the many specimens described by authors as species of *Widdringtonites*[4] are indistinguishable from vegetative shoots of *Cyparissidium*. So far as we know the occurrence in Arctic floras of conifers which can confidently be referred to the Callitrineae has not been demostrated.

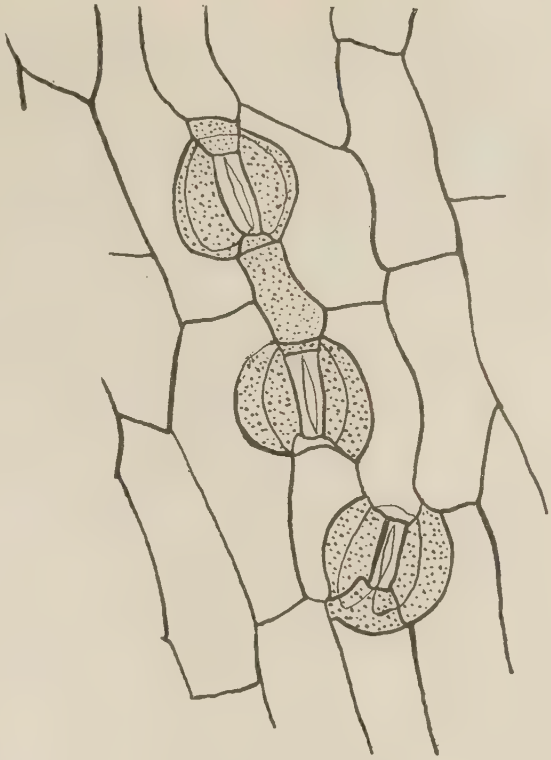
Atanikerdluk; Upernivik Naes.

Protophyllocladus Berry.

The name *Protophyllocladus* was instituted by Berry[5] for Cretaceous fossils previously included in *Thinnfeldia*, a wide-spread genus in Triassic and Jurassic floras placed by authors in various positions in the plant-kingdom. We now know that some at least of the *Thinnfeldia* species are Pteridosperms, though there is no good reason for believing that the Cretaceous specimens formerly assigned to that genus are direct descendants of earlier Mesozoic

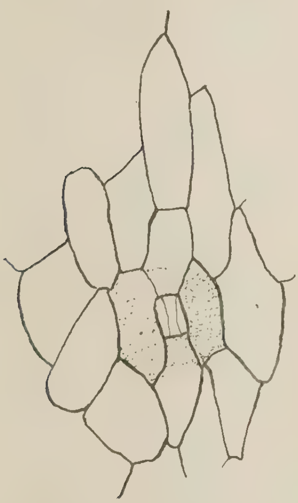
[1] Seward (26), p. 103.
[2] Hollick (30), Pls. XV—XVII, ×1.
[3] Seward (26), p. 111.
[4] *e. g.* Berry (11), Pl. LXXIII; Newberry (95), Pl. VIII.
[5] Berry (03), p. 440.

seed-bearing plants. BERRY regarded the Cretaceous fossils referred to *Thinnfeldia* as phylloclades similar to those of the Conifer *Phyllocladus*. There is yet no proof of relationship. In the hope of discovering evidence of affinity cuticular preparations were made of Greenland examples of *Protophyllocladus subintegrifolius* BERRY and of phylloclades of recent species of *Phyllocladus*. Text-fig. 12 shows the cuticle of *Phyllocladus trichomanoides* and text-fig. 13 shows a stoma of *Protophyllocladus subintegrifolius*. Comparison of the cuticles does not enable us to express a definite opinion on the question of relationship: in both the stomatal opening is surrounded by four subsidiary cells; but a similar arrangement occurs in Cycadophyte fronds. It is, however, certain that this species of *Protophyllocladus* is not a fern.



Text-fig. 12. *Phyllocladus trichomanoides*. Stomata. × 300. (J. S. L. Gilmour.)

An examination of published figures reveals a lack of clearly defined characters distinguishing the species of BERRY's genus. *Protophyllocladus lanceolatus* (*Thinnfeldia lanceolatus* KNOW.) as illustrated by KNOWLTON[1] can hardly be separated from *P. subintegrifolius*, which, as seen in NEWBERRY's figures[2], was represented by many forms.



Text-fig. 13. *Protophyllocladus subintegrifolius* BERRY. Stoma. (J. S. L. Gilmour.)

Protophyllocladus subintegrifolius (LESQ.) BERRY. Pl. VI, fig. 30 (nat. size). Text-fig. 13.

This specimen may be compared with that figured by HEER[3] and NEWBERRY[4] as *Thinnfeldia Lesquereuxiana* though it is rather larger and there is no indication of lobing. The terminal lamina tapers downwards into a winged axis to which are attached two smaller laminae. We are not sure if it is a foliage-shoot, a branched axis with phylloclades, or a

[1] KNOWLTON (93), Pl. V, 5.
[2] NEWBERRY (95), Pl. XI.
[3] HEER (82), Pl. XLVI, 11.
[4] NEWBERRY (95), Pl. XI, 8, 9.

frond. HOLLICK's Alaskan specimens referred by him to *Protophyllocladus subintegrifolius*[1] may be specifically identical with ours, but the margin does not appear to be quite entire: his *P simplex*[2] has an entire margin and closely resembles the Greenland form. The specimens examined by us are imperfectly preserved and it is difficult to say whether or not the margins are entire.

Protophyllocladus had a wide range in Cretaceous floras of North America[3], and the genus is recorded from Sakhalin Island[4] as well as from Greenland.

Atanikerdluk.

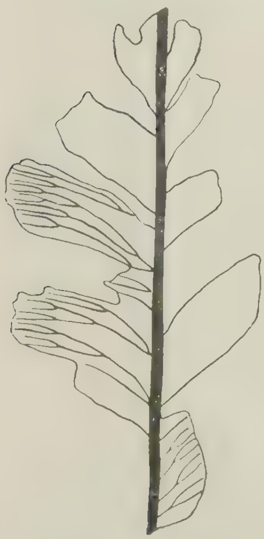
Protophyllocladus polymorphus (LESQ.) BERRY. Pl. VI, fig. 32 (nat. size).

The lamina of this specimen is distinguished by its greater breadth; it has a thick stalk and midrib; the apex is lacking. We refer it with some hesitation to *P. polymorphus*[5] in view of its imperfection, and more especially because the three species recognized by BERRY — *P. polymorpha*, *P. subintegrifolius* and *P. lanceolata* — appear to be closely allied and are very variable in size and in the lobing of the lamina.

Atanikerdluk.

Plantae incertae sedis.

Phyllites borealis sp. nov. Text-fig. 14.



Text-fig. 14. *Phyllites borealis* sp. nov. Nat. size. K. (F. W. Shotton.)

This torn specimen is figured as an example of a plant fragment which appears to be unlike any previously recorded species: it is 6.5 cm. long and 3 cm. wide: the lamina may have been originally lobed, but the deep sinuses are certainly, in part at least, due to tearing. There is a relatively strong midrib to which the lamina is laterally attached; a characteristic feature is the repeated bifurcation of the lateral veins as they pass obliquely upwards. The preservation is too imperfect to admit of any examination of the epidermal characters. We prefer to adopt the generic name *Phyllites* in preference to *Taeniopteris*. Leaves having similar venation have been referred to *Saccoloma*[6], *Osmunda*, and *Marattia*[7]; but the nature of the specimen cannot be determined. In venation our specimen resembles *Phyllites asplenoides* BERRY[8] from the Upper Cretaceous of Tennessee; but it is certainly not the same plant.

Atanikerdluk.

[1] HOLLICK (30), Pl. XIV, 1—3. [2] *Ibid.*, Pl. XIV, 4, 5.
[3] BERRY (29), p. 133. [4] KRYSHTOFOVICH (18), p. 41.
[5] For references and figures see HOLLICK (30), p. 51.
[6] KNOWLTON (30), Pl. III, 5.
[7] FRIČ and BAYER (01), fig. 25.
[8] BERRY (19), Pl. 33.

Angiospermae.

Magnoliaceae.

HEER assigned three species of Cretaceous leaves from Greenland to *Magnolia; M. alternans*, *M. Capellini*, and *M. Newberryi*. From a careful examination of a large number of specimens from Atanikerdluk Mr SHOTTON was able to recognize HEER's three species and added a fourth. In all probability *M. alternans* and *M. Capellini* should not be merged into a single species as was done by one of us in 1926. The following account of the fourth species is based upon a description written by Mr SHOTTON.

Magnoliaephyllum[1] **Thomsenianum** (HEER) SHOTTON, Text-figs. 15, 16.

Magnolia Capellini HEER (74), *ex parte*, Pl. XXXIII, fig. 4.
Apeibopsis Thomseniana HEER (82), p. 95, Pl. XXXVI, 5.
Magnoliaephyllum alternans SEWARD (26), p. 120; text-fig. 25.

A large series of specimens from Atanikerdluk has greatly increased our knowledge of leaves believed to be foliage of trees closely akin to recent species of *Magnolia*. Some of the specimens are almost certainly specifically identical with HEER's *Apeibopsis* from Igdlokunguak, and show much clearer

Text-fig. 15. *Magnoliaephyllum Thomsenium* (HEER). Nat. size. (F. W. Shotton.)

Text-fig. 16. *Magnoliaephyllum Thomsenianum*. Fungus on leaf. Nat. size. (F. W. S.)

venation. The leaf of this species is subcircular; the apex is either very obtuse, completely rounded, or even slightly re-entrant: the basal margin joins the petiole at an angle of from 45° to 85°. The leaf has a maximum length of about 9 cm.; its width is usually less, the average ratio of length to breadth

[1] We are indebted to Mr J. E. DANDY for drawing our attention to the generic name *Magnoliastrum* proposed by GOEPPERT in 1854 for some fossil leaves from Java which he compared with the foliage of recent species of *Magnolia* (Die Tertiärflora auf der Insel Java, p. 50). GOEPPERT's generic designation, though less appropriate than *Magnoliaephyllum*, has priority.

being approximately 1.15. Four or five strong secondary veins are attached to the strong midrib at an angle of about 40°; at some distance from the margin they are connected with one another by simple forking and form a series of narrow lobes. The basal secondary vein is marginal and much thinner than the others, a feature shared by *M. Capellini* and *M. alternans;* slender veins occur between the stronger secondaries. A few of the specimens show tertiary viens. In leaf-form there is some overlapping in the three species *M. Thomsenianum*, *M. Capellini*, and *M. alternans*, but when all the characters are considered there would seem to be good evidence of the existence of three species.

	M. Thomsenianum text-figs. 15, 16)	*M. Capellini* (text-fig. 17	*M. alternans* (text-fig. 18)
Apex of leaf	blunt or rounded, occasionally reentrant	acute	very acute
Base of lamina	obtuse, 90°—160°	rather acuminate 60°—100°	Pointed, 45°—90°
Mean ratio of length to breadth	1·15	1·65	greater than 2·2
Angle of divergence of secondary veins	about 40°	30° or less	about 45°

While it is hardly possible to estimate the degree of relationship of the fossil species to recent members of the genus *Magnolia*, it is noteworthy that *M. Thomsenianum* agrees very closely with the recent species *M. globosa:* in both there is a strong midrib, well developed secondaries with weaker veins between them, a thin basal, marginal secondary vein, and a similar tertiary venation. A piece of leaf of *M. Thomsenianum* is seen in text-fig. 15.

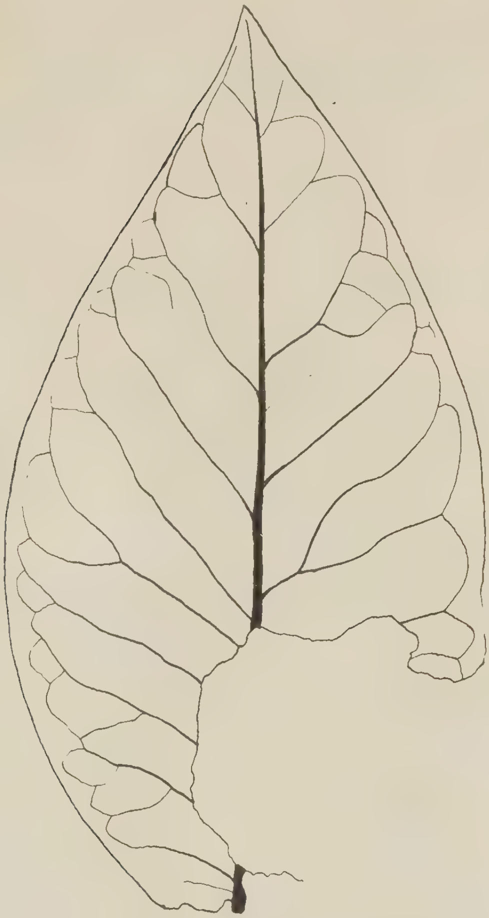
Mr SHOTTON noted the occurrence on leaves of *M. Thomsenianum* of small scale-like patches, reaching 5 mm. in diameter, irregular both in size and shape, which are in all probability a fungus (text-fig. 16). On magnification each scale is seen to have a punctate ornamentation: some show a reticulum of fine cracks, due to shrinkage. No fungus was found on the other species.

Part of a leaf of *M. Capellini* is shown in text-fig. 17, and a leaf of *M. alternans* in text-fig. 18: text-figs. 15—18 were drawn by Mr SHOTTON from Atanikerdluk specimens.

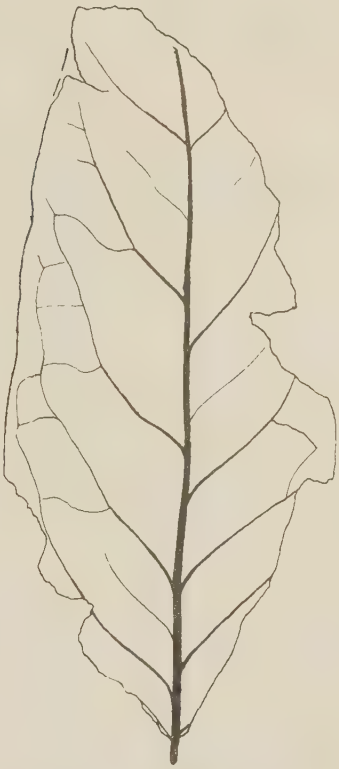
It is practically certain that trees with leaves and fruit agreeing generally with those of surviving species of *Magnolia* were abundantly represented in Cretaceous and Tertiary forests. The mass of fruits figured by HEER as *M. Inglefieldi* from Atanikerdluk[1] is, we believe, correctly referred to *Magnolia:* the specimen is in the British Museum. Comparison of the present[2]

[1] HEER (69). Pl. LI, 2, 3.

[2] DANDY & GOOD (29).



Text-fig. 17. *Magnoliaephyllum Capellini* HEER. Nat. size. (F. W. S.)



Text-fig. 18. *Magnoliaephyllum alternans* HEER. Nat. size. (F. W. S.)

and past distribution of *Magnolia* affords an impressive example of the importance of records of extinct species as aids to a better understanding of the wanderings of plants.

Atanikerdluk.

Magnoliaephyllum Newberryi BERRY.

Magnolia Newberryi BERRY (07), p. 195, Pl. XIII, fig. 6.
M. longifolia NEWBERRY (95), p. 76, Pls. LV, figs, 3, 5; LVI, figs. 1—4.

No complete leaves were found, but many specimens from which Mr SHOTTON was able to form a fairly clear idea of the shape. Some of the Greenland examples are as large as the leaf figured by NEWBERRY[1] in his Pl. LVI, fig. 1, and even larger. Strong secondary veins spring from the midrib at about 50° and follow a straight course until near the margin where they curve upwards: there is a thin, basal secondary vein, and between each pair of strong secondaries at least one thinner, parallel vein. *M. Newberryi*

[1] NEWBERRY (95).

is longer in proportion to its breadth than *M. Capellini*, and the former species widens rapidly from the base to a maximum at about a quarter of the length when it gradually tapers towards the apex. *M. Capellini* has its maximum breadth at about the middle. HEER's incomplete leaf from Sinigfik[1] named *M. regalis* may be *M. Newberryi*.

Atanikerdluk.

Magnoliaceae?

Magnoliaestrobus gen. nov.

Magnoliaestrobus Gilmouri sp. nov. Pl. IV, fig. 20 (nat. size).

A partially petrified strobilus from Kardluk, which seemed to promise anatomical information, was ground to a flat surface and photographed at different levels. Unfortunately only carbonized outlines were found as seen in the surface reproduced in fig. 20 — approximately median in the lower part. The specimen, 9×3.5 cm., tapers gradually upwards; the base is not preserved: the appendages are spirally attached and have a prominent and thick distal prolongation directed upwards. We at first thought that the fossil is probably an imperfect cone of a conifer with very stout cone-scales without any trace of seeds and no indication of bract-scales. On further consideration we believe the specimen to be an aggregate of fruits of a *Magnolia:* an old infructescence of a recent species of *Magnolia* (possibly *M. tripetala*, an Eastern American species) is shown in Pl. VI, fig. 33: if the gaping follicles were filled with sand the size and shape of them would agree closely with the appendages shown in Pl. IV, fig. 20. Another striking resemblance is the thick style which projects upwards from each fruit in the recent example and in the fossil. Comparison may also be made with HEER's *Magnolia Inglefieldi*[2] from the Tertiary plant-beds of Atanikerdluk.

Kardlok.

Menispermaceae.

Menispermites Nordenskiöldi (HEER) SEWARD.[3] Text-fig. 19.

Apeibopsis Nordenskiöldi HEER (74^2), p. 23, Pl. V, fig. 6.
Pterospermites cordifolius HEER (82), p. 94, Pl. XXVII, fig. 3.

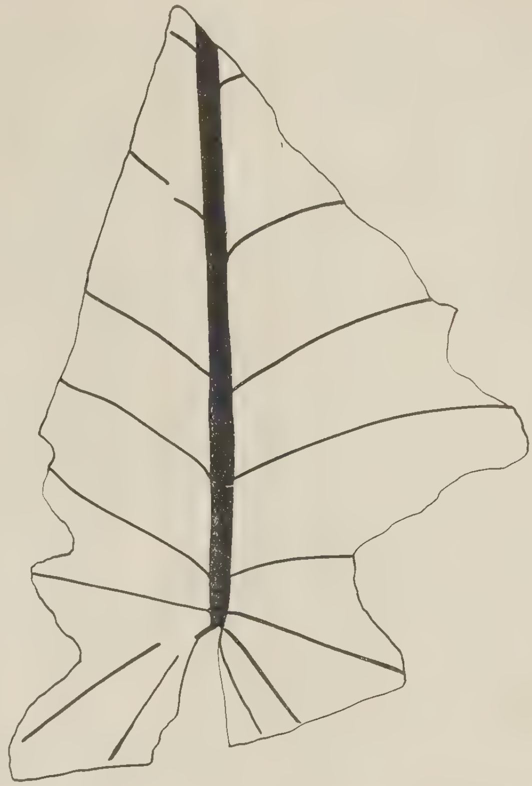
The single specimen, though very incomplete, is referred to HEER's species on the ground of its venation: the strong midrib and backwardly directed secondary veins at the base of the lamina. The other secondaries make an angle of about 60° with the midrib and are slightly arched downwards. Leaves having similar venation have been assigned to *Protophyllum* and *Pseudoprotophyllum*.[4]

Atanikerdluk.

[1] HEER (83), Pl. CVIII, 1. [2] HEER (69), Pl. LI, 2, 3.
[3] SEWARD (26), p. 117, text-fig. 23. [4] HOLLICK (30), p. 91,

Myrtaceae.

Leptospermites arcticus sp. nov. Pl. V, figs. 23, 27 (×5); Pl. VI, fig. 29 (×1 ½).



Text-fig. 19. *Menispermites Nordenskioldi* (HEER). Nat. size. (V. C.) K.

The specimen on which this species is founded is difficult to describe with clearness owing to imperfect preservation: it consists of incomplete linear aggregates of fruits crowded on unbranched axes; the longest axis is 3.5 cm. and about 6 mm. in breadth. The fruits are more or less crushed and were, we imagine, originally globose; some of them show five prominent ridges radiating from a central point: the ridges are clearly seen in figs. 23 and 27. Seen in side-view the ridges, which we believe indicate the position of dehiscing loculi, curve regularly from the base to the apex of each fruit: the fruits are 3—4 mm. in diameter. The whole gives the impression of an aggregate of syncarpous, five-merous carpels. Though it would be rash to regard this fossil as evidence of the former occurrence in Greenland of a member of the Myrtacae, we venture to think that the fruit-bearing axes are sufficiently similar to those of *Leptospermum* (Malay region, Australia and New Zealand) and *Callistemon* to be described as probably Myrtaceous. We adopt the name *Leptospermites*, which was first used by SAPORTA[1] for leaves in the plant-beds of south-eastern France. This designation was used by SCHMALHAUSEN for specimens of fruit-bearing axes from Lower Tertiary beds in south-western Russia: his species, *Leptospermites spicatus*[2], is based on globular fruits very like ours, possibly the same species: compare especially his Pl. XXXVIII, figs. 8 and 9. He described another species, *L. crassifragmus*[3], which appears to be very close to *L. spicatus*, a New Zealand species. DEPAPE[4] has recorded *L. spicatus* from the étage Landénien (Eocene) in northern France and the same author records *Myrtophyllum Warderi*[5] LESQ., founded on leaves, from

[1] SAPORTA (62), p. 284.

[2] SCHMALHAUSEN (84), p. 319, Pl. XXXVI, 29 *b*; Pl. XXXVII, 7 *b*, *c*; Pl. XXXVIII, 8—15.

[3] *Ibid.*, Pl. XXXVI, 29—31.

[4] DEPAPE (25), p. 39, Pl. I, 19.

[5] *Ibid.*, p. 37,

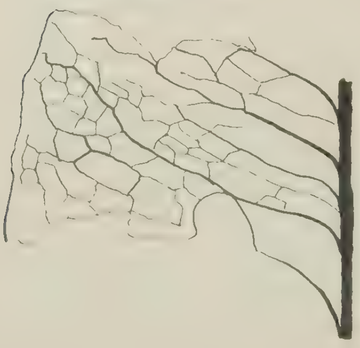
the same locality, which have been assigned to *Eucalyptus Geinitzi*.[1] HEER figures a specimen from the plant-beds of the Svartenhuk Peninsula, regarded by him as Tertiary, which bears a close resemblance to our fruits: he describes it as a Fruchtzapfen of *Alnus Kefersteinii*.[2]

In the genera *Callistemon* and *Melaleuca* the fruits are borne in compact clusters as in *Leptospermites arcticus*, but the form of the individual fruits differs from that of ours: the fruits of *Leptospermum*, though not so closely packed, are practically the same as in the fossil. We draw special attention to the recent species *L. scoparium*, in which the five-locular fruits are borne in loose clusters. Dr FLORIN[3] described a fruit from the late Tertiary flora of Japan as cf. *Stuartia* sp. believed by him to resemble closely the fruits of the recent genus which occurs in the Far East and in the south-eastern part of North America: his fruit is a single one and, while it resembles ours, it is not so close a match as the clustered fruits of *Leptospermites*. It is worth recording that a fruit, *Stuartia pseudo-camellia*, is described by the REIDS[4] from the Pliocene of Reuver. *Stuartia* is a genus of Theaceae; its fruits are larger and more conical than those of *Leptospermum* and are not borne in crowded clusters. It may also be pointed out that Mrs REID and Miss CHANDLER[5] regard *Hightea elliptica* BOWERBANK from the Eocene flora of the London clay as possibly a Myrtaceous fruit.

The Greenland fruits are not associated with recognizable leaves: on one of the two specimens there is a poorly preserved, lanceolate leaf which agrees in size and shape with leaves of *Leptospermum;* but the material is of little value.

This fossil species raises the controversial question, which cannot be fully discussed here, namely the former occurrence in Arctic regions of genera that are now Australasian. Our view is that the family Myrtaceae was represented in the Cretaceous flora of Greenland.

Atanikerdluk.



Text-fig. 20. *Myrtophyllum boreale* sp. nov. ×2. (V. C.) K.

Myrtophyllum boreale sp. nov. Pl. V, fig. 28 (×1 1/2); text-fig. 20.

We include this fragment with some hesitation in HEER's genus *Myrtophyllum*. From a prominent midrib numerous secondary veins are given off at a wide angle and fork near the margin, forming intra-marginal loops: there are weaker intermediate veins parallel to the stronger ones. Text-fig. 20 shows the venation more clearly. The margin is not perfectly preserved and one cannot be sure whether or not there

[1] KNOWLTON (19), p. 401.
[2] HEER (83), Pl. 96, 7.
[3] FLORIN (20), p. 34, Pl. VI, 5, 6.
[4] REID, C. and E. M. (15), Pl. XIII, 7—16.
[5] REID and CHANDLER (33), Pl. XXIV, 1—17.

was a marginal vein as in *Eucalyptus*. The breadth of the specimen when complete must have been about 5 cm. Leaves having similar venation have been referred to *Ficus*, *Eucalyptus*, *Pseudomelia*, *Celastrophyllum*, *Anacardites*, *Sapindus* and *Myrtophyllum:* though we do not presume definitely to regard the Greenland fossil as an undoubted Myrtaceous species, we venture to assign it to *Myrtophyllum*. The specimen in our collection agrees very closely with a leaf figured by HEER from Atane beds at Skandsen (Disko Island): in venation and form it appears to be identical. HEER includes the Skandsen leaf with others from several localities in *Sapindus Morrisoni* LESQ., but most of the specimens so named have a different venation and are distinct from ours. Moreover, the original specimens of LESQUEREUX from the Cretaceous formation of Colorado are not the same type as our incomplete leaf and one of LESQUEREUX's specimens is probably part of a compound leaf. It is indeed possible that the fragment may belong to a leaf of *Eucalyptus*, some species of which have very much the same type of venation, e. g. *E. ficifolia* and *E. haematoxylon*.[1] Comparison may also be made with leaves of the Australian genus *Angophora*, and with those of *Grevillea Goodi*, which are similar to the *Eucalyptus* type.

Amisut.

Leguminosae.

Bauhinites groenlandica sp. nov. Text-fig. 21.

This species is founded on an incomplete specimen: it is obcordate, 6 cm. broad, with a deep distal sinus; the midrib and lateral veins differ but little

Text-fig. 21. *Bauhinites groenlandica* sp. nov. Nat. size. (F. W. S.)

in prominence; the lateral primaries diverge from the petiole and fork near the margin where they form loops with the secondary veins. The leaf bears a close resemblance to *Bauhinia glauca* WALL., a recent Indian species; it is also similar to *B. macrantha* OLIV., a South African species, a type which CHANEY compares with a Tertiary form recently described by him from Uganda

[1] MAIDEN (22), Pls. CLXXVI—VII.

as *B. Waylandi.*[1] A leaf similar to ours, though differing in the narrower lamina and the less rounded apical depression, is figured by BERRY[2] from the Upper Cretaceous of Alabama as *Sapotacites shirleyensis* and compared by him with HEER's *Colutea protogaea*[3], a species which may belong to *Dalbergites*. Among other fossil records are *Bauhinia marylandica*[4] BERRY, *B. alabamensis* BERRY, *B. ripleyensis*[5] BERRY and *B. cretacea*[6] NEWB.

The genus *Bauhinia*, which now occurs in the tropics and sub-tropics of the Old and the New World, formerly had a much more extended northerly range.

Atanikerdluk.

Dalbergites simplex (NEWB.) SEWARD. Text-fig. 22—24.

The nature of the specimens described by HEER and other authors as complete leaves and assigned to *Liriodendron* was fully discussed by one of us in 1925[7]; evidence was given for the adoption of the generic name *Dal-*

Text-fig. 22. *Dalbergites simplex* (NEWBERRY), showing range in leaf-form. 3/4 nat. size. (F. W. S.)

[1] CHANEY (33), p. 706.
[2] BERRY (19), Pl. XXIX, 4—6.
[3] HEER (83), Pls. LXI, 1 c; LXII, 1 c.
[4] BERRY (08), figs. 1—3.
[5] BERRY (19), Pl. XXIII, 7.
[6] NEWBERRY (95), p. 91.
[7] SEWARD (25), p. 20.

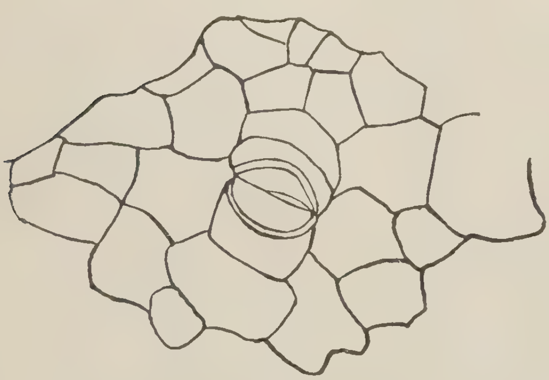
bergites and for calling the supposed leaves leaflets. Two species were recognized, *Dalbergites simplex* and *D. borealis,* the former from Atanikerdluk and Igdlokunguak and the latter from Patut. Many additional specimens have now been examined: text-fig. 22 illustrates the range in size and form of leaflets included in *D. simplex.* The incomplete specimen shown in text-fig. 23 is the only one in which we found a petiole attached to a leaflet; the slender stalk is similar to those of the leaflets of some recent species of *Dalbergia.*

Text-fig. 23. *Dalbergites simplex* Leaflet and petiole. Nat. size. K. (F. W. S.)

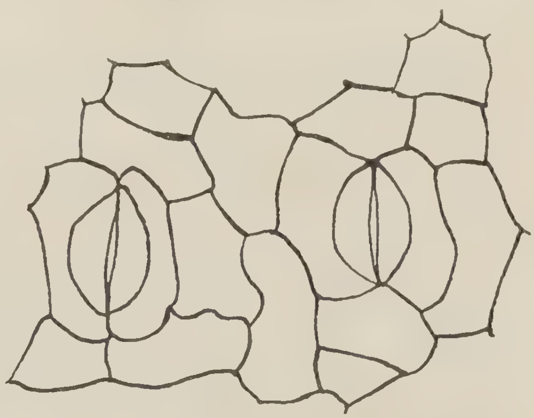
It should be pointed out that in form the leaflets of *Dalbergites* closely resemble those of *Amicia zygomerus*, a Leguminous species from the South American Andes, but the venation is different.

Atanikerdluk.

Mr Gilmour made preparations of the cuticle of some of the leaves from Atanikerdluk, and the best he was able to obtain were from unpromising material of what we believe to be *D. simplex.* As text-fig. 24 shows, two parallel cells accompany the guard-cells of the stoma; the epidermal cell-walls are not sinuous. The stomata of the fossil leaf bear a close resemblance to those of *Dalbergia* and *Pterocarpus*, the two recent genera with which Heer's



Text-fig. 24. *Dalbergites simplex.* Stoma. ×600. (J. S. L. Gilmour.)



Text-fig. 25. *Pterocarpus indicus.* Stomata. ×600. (J. S. L. G.)

supposed *Liriodendron* was previously compared. A stoma of a *Pterocarpus* leaf is shown in text-fig. 25. In leaves of a recent species of *Myrsine* (Myrsinaceae), a genus to which Heer[1] referred leaflets, which have been renamed *Dalbergites borealis*, the epidermal cells were found by Mr Gilmour to be very sinuous, and the guard-cells surrounded by a ring of 3—4 subsidiary cells. Heer's *Myrsine consobrina*[2], which is no doubt *D. borealis*, was de-

[1] Heer (74), p. 113.
[2] Heer (83), Pl. CVII. 11.

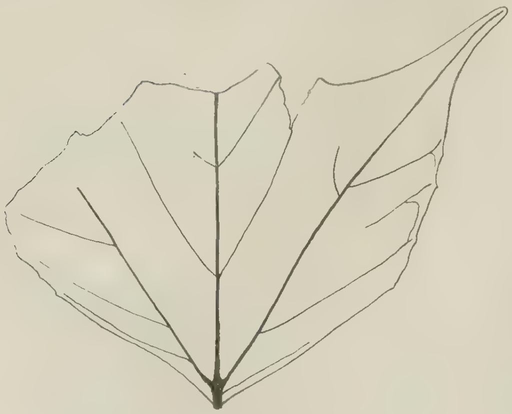
scribed by HEER from Puilasok, spoken of by him, we believe incorrectly, as a Tertiary locality.

Atanikerdluk, Igdlokunguak.

Platanaceae.

Platanus Newberryana (HEER), text-fig. 26.

Acer caudatum HEER (83), p. 38, Pl. LXV, figs. 1, 2.
Platanus Newberryana SEWARD (26), p. 128, text-fig. 30; Pl. XI, fig. 116.



Text-fig. 26. *Platanus Newberryana.* Nat. size. (V. C.)

The incomplete leaf from Patut shown in the text-figure is probably a *Platanus* and not *Acer*. We do not regard the elongate, acuminate lobe as a character worthy of specific rank, but as a variant of the species. In leaves of *Platanus* and *Acer* the apices of the lateral lobes vary in shape: some examples of Swiss Tertiary species included by HEER in *Acer trilobata* agree in the possession of driptips with our specimen, but they are associated with fruits of *Acer*.

Patut.

Platanus sp. Pl. VI, figs. 31, 34 (nat. size).

The collection includes several well preserved leaf-impressions in sandstone collected by Dr HARTZ at Urnatok, Disko Island, which are specifically the same as *Platanus Guillelmae* GOEPP. and *P. marginata* (NEWB.) figured by HEER[1] from the same locality. HEER's two 'species' are indistinguishable and *P. Guillelmae*, as MEYER[2] says, is no doubt the same as GOEPPERT's *P. aceroides*. A small, trilobed leaf from Urnatok is shown in Pl. VI, fig. 34 and some fruits in fig. 31. In his account of the Urnatok leaves HEER stated that the blocks of rock containing the fossils were found in the bed of a stream near Cretaceous beds, and he could not be sure whether the *Platanus* was Tertiary or Cretaceous in age. It is the intention of the senior author to describe the leaves collected by Dr HARTZ at Urnatok in a separate paper on the past and present distribution of the genus *Platanus*. We now reproduce photographs of two Urnatok specimens without, at present, employing a specific name.

Many authors[3] from their knowledge of the polymorphism of the foliage of both recent and fossil species have realized the impossibility of delimiting true specific types, and it has become customary to employ GOEPPERT's name

[1] HEER (83), Pls. XCVIII, XCIX, CI.
[2] MEYER in KRÄUSEL (19), p. 164.
[3] See MEYER in KRÄUSEL (19), p. 166; also CHANEY (33[2]), pp. 15, 78.

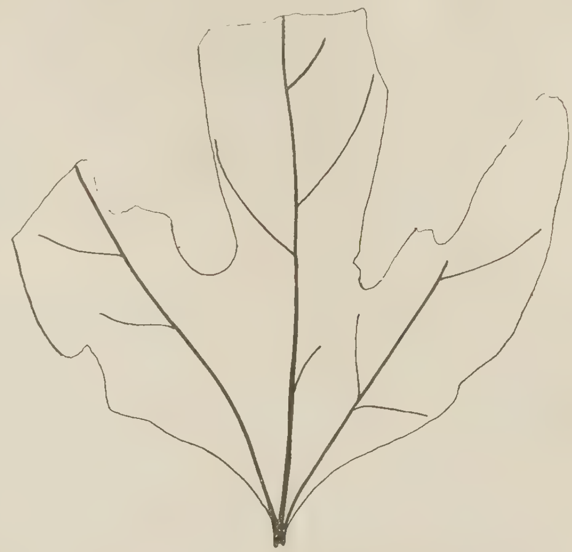
Platanus aceroides[1] in a wide sense as denoting a group of forms which it would be hopeless to attempt to assign to well-defined species. It is indeed impossible to draw a satisfactory line between Cretaceous, Tertiary, and recent species. The large leaves figured by KNOWLTON[2] from the Tertiary Raton formation (Colorado and New Mexico) as *P. aceroides latifolia* are indistinguishable from Urnatok specimens. *P. marginata* LESQ. is recorded by KNOWLTON[3] from the early Tertiary Denver Formation of Colorado and Wyoming.

It may well be that the foliage of Cretaceous and Early Tertiary species exhibited an even greater range in external characters than we find in modern Plane trees. The occurrence at Urnatok in the same bed of sandstone of leaves from 5.5 cm. to 15 cm. in breadth, some trilobed, some almost orbicular, may be regarded as evidence of derivation from a single species.

Patut, Urnatok.

Platanophyllum insigne (HEER). Text-fig. 27.

This specimen is probably the species figured by HEER from Igdlokunguak as *Aralia groenlandica*[4], which was subsequently transferred to *Platanophyllum*.[5]



Text-fig. 27. *Platanophyllum insigne* (HEER). Nat. size. (V. C.)

Igdlokunguak, Atanikerdluk, Kardlok.

Sapindaceae?

Sapindopsis angusta (HEER). Pl. V, fig. 24 (nat. size). Text-figs. 28, 29.

Cassia angusta HEER (82), p. 101, Pl. XXVII, fig. 6.
?*Inga Cottai* ETTINGSHAUSEN (67), p. 262, Pl. III, fig. 18.
Sapindopsis variabilis FONTAINE (89), p. 298, Pls. CLI—CLV.

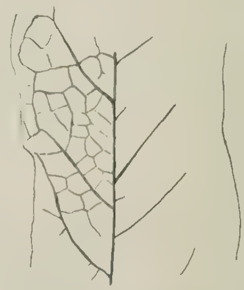
This specimen, as Mr SHOTTON pointed out, is almost certainly the same species as *Cassia angusta* HEER[6] from Atanikerdluk: ours shows the apical part, which is lacking in the type-specimen. HEER regarded the leaf as specifically identical with *Palaeocassia angustifolia* ETT.[7] from Niederschöna, but

[1] GOEPPERT (55), p. 21, Pl. IX, 1—3.
[2] KNOWLTON (17), Pls. XCII, XCIII, 3. XCIV.
[3] KNOWLTON (30), p. 80.
[4] HEER (82), Pl. XXXVIII, 3.
[5] SEWARD (26), p. 132.
[6] HEER (82), p. 101, Pl. XXVII, 6.
[7] ETTINGSHAUSEN (67), Pl. III, 6—8.

Text-fig. 28. *Sapindopsis angusta* (HEER). Nat. size. K.

this is very doubtful: the fragment figured by ETTINGSHAUSEN as *Inga Cottai*[1] may, however, belong to *Cassia angusta*. Our view is that HEER's species is more likely to be a *Sapindus*.

FONTAINE[2] proposed the generic name *Sapindopsis* for pinnate leaves from the Potomac formation which, he said, »seem to be at least ancestral forms of *Sapindus*»: he instituted several species, some of which — *S. variabilis*, *S. magnifolia*, and to a less extent *S. brevifolia* — agree closely with the fossil shown in fig. 24. BERRY[3] records these three species from the Cheyenne Sandstone of Kansas, which he regards as Upper Cretaceous, and gives a useful account of their relationship and distribution. As he says, there is little difference between the leaves assigned to *S. variabilis* and *S. magnifolia*. Our specimen may be specifically the same as *S. variabilis*. The rachis is incompletely preserved; it appears to be slightly winged: there are six leaflets (text-fig. 28); the two uppermost are partially coalescent along the tip of the rachis, a feature noted by BERRY in the American leaves. The leaflets are opposite, broadly linear, with an asymmetrical base. The venation is camptodrome; the secondary veins are given off at an acute angle; the tertiary veins form an irregular reticulum (text-fig. 29). Comparison with the photographs reproduced by BERRY and with leaves of recent species of *Sapindus* supports the adoption of both the generic and the specific name. HEER's *S. densifolius*[4] from Switzerland resembles our specimen. It is noteworthy that NEWBERRY's *S. affinis*[5] from the Yellowstone River, Montana, recorded by him as 'Eocene?' is another very similar leaf. The present distribution of *Eusapindus* is shown on a map given by LA MOTTE[6] in a paper on *Sapindus oregonianus* KN. from Nevada, in which are reproduced leaflets of recent species agreeing closely with our form.



Text-fig. 29. *Sapindopsis angusta*. Venation. ×2. K.

Atanikerdluk.

[1] *Ibid.*, Pl. III, 18.
[2] FONTAINE (89), p. 296.
[3] BERRY (22), p. 213.
[4] HEER (59), Pl. CXX, 1.
[5] NEWBERRY (98), Pl. XXX, 1.
[6] LA MOTTE (35).

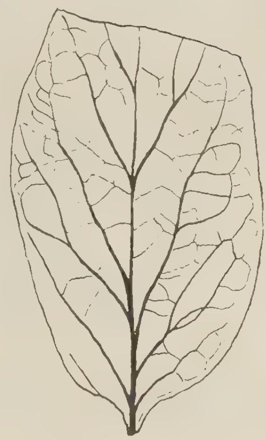
Dicotyledones incertae sedis.

Dicotylophyllum ovale (Lesquereux). Text-fig. 30.

Hedera ovalis Lesquereux (74), p. 91, Pl. 25, fig. 3.
» » » (91), p. 129, Pl. 17, fig. 15.
Populus Stygia Heer, *ex parte* (82), Pl. 18, fig. 6.

The leaf shown in text-fig. 30 agrees with *Hedera ovalis* Lesq. in its oval shape and narrowed base, the midrib becoming less well defined towards the apex, and in the flexuous secondaries and finer venation. One of Lesquereux's figures[1] in his earlier work differs in the straighter veins and the more sinuous margin. A specimen figured by Heer as *Populus Stygia* is different from the others referred to that species and closely resembles Lesquereux's species, which is from Cretaceous rocks in Nebraska and Kansas.

Atanikerdluk.



Text-fig. 30. *Dicotylophyllum ovale* (Lesquereux). × 1 1/2. (F. W. S.) K.

Cinnamomoides sp. Cf. **Cinnamomum mississipiensis** Lesq. Text-fig. 31.

The specimens included in *Cinnamomoides* are incomplete examples of a common type of venation which has usually, and on unconvincing evidence, been regarded as indicative of close relationship to *Cinnamomum;* while resembling *C. Newberryi*[2] and other species, they agree still more closely with *Cinnamomum mississipiensis* as described by Lesquereux, Berry[3] and other authors, and may be compared also with some leaves included in *Ficus*, e. g. *Ficus pseudopopulus* Lesq., from the Denver flora.[4] Leaves having the form and venation of the specimens shown in text-fig. 31 cannot, in our view, be referred with any degree of confidence to a recent genus.

Patut.

Text-fig. 31. *Cinnamomoides* sp. Nat. size. (V. C.) K.

Dicotylophyllum Shottoni sp. nov. Pl. V, fig. 25 (very slightly enlarged); text-fig. 32.

The specimen on which this species is founded and named after Mr Shotton, who made a preliminary examination of the material submitted to us, is an orbicular leaf with a slightly decurrent base, and the margin, where

[1] Lesquereux (74), Pl. 26, 4.
[2] Seward (26), p. 124.
[3] Berry (25), Pl. 16, 7.
[4] Knowlton (30), Pl. 26, 2—4.

it can be seen, is entire. From a stout midrib 4 to 6 secondary veins are given off which curve upwards until they are almost parallel with the midrib: there is a slender marginal vein at the base. The tertiary veins form marginal loops. This leaf resembles LESQUEREUX's figures[1] of *Populus hyperborea* HEER, but it differs from the original illustrations of that species.[2] We therefore adopt a new name and include as a synonym the Dakota leaf figured by LESQUEREUX. We prefer to use the non-committal generic name *Dicotylophyllum;* it is possible that the leaf is that of a Poplar, but in *Populus* the secondary veins are less curved and the leaves are frequently not entire.

Atanikerdluk.

Text-fig. 32. *Dicotylophyllum Shottoni* sp. nov. ×1 ½. (V. C.)

Planta incertae sedis.

An Angiospermous infructescence. Text-fig. 33.

The imperfectly preserved specimen shown in text fig. 33 is an axis bearing short, alternate branches on each of which are several, crowded fruit-like bodies. The clusters are about 1.5 cm. long and 0.7 cm. wide: there appear to be approximately ten fruit-like bodies in each group, spirally disposed. The individual bodies are obovate, sometimes slightly curved upwards, 3—4 mm. long and 2—3 mm. broad, with a narrow marginal membrane surrounding a central thicker part. There is some resemblance between these fruits, or seeds, and HEER's *Myrica thulensis*[3], but we cannot say if this is significant. Some of FONTAINE's Potomac fossils, *Carpolithus agglomertus*[4] and others, which are equally obscure, are not unlike our specimen.

Igdlokunguak.

Text-fig. 33. *Planta incertae sedis.* Nat. size. (V. C.)

[1] LESQUEREUX (91), Pl. III, 9, 10.

[2] HEER (71), Pl. XXIX, 9; Pl. XXX, 2 b.

[3] HEER (74), Pl. XXXI, 1 c; (83), Pl. XLVI, 26.

[4] FONTAINE (89), Pl. CXXXIV.

Conclusion.

The following list includes the species described or recorded in the foregoing pages with the localities. A fuller list will be found in the paper of 1926. The geological age as given by HEER is added to each locality though we do not regard his threefold division of the Greenland Cretaceous rocks as a classification based upon satisfactory evidence. Maps of the region with which we are concerned have already been published.[1]

	Atanikerdluk (Atane)	Patut (Patoot)	Kuk (Kome)	Upernivik I (Atane)	Igdlokunguak (Atane)	Other localities
Equisetites amissus		×				
Equisetites sp.	×					
Gleichenites Gieseckiana			×			
G. Nordenskiöldi	×	×	×			
G. Porsildi	×					
Hausmannia Dicksoni	×					
Laccopteris latifolia	×					
Sphenopteris groenlandica		×				
S. (*Onychiopsis?*) *Johnstrupi*			×			
Sphenopteris sp.					×	
Cladophlebis frigida var. *longipennis*	×					
Pseudocycas Thomasi				×		
P. Steenstrupi				×		
Pterophyllum Harrisi				×		Kardlok
Pseudoctenis latipennis						Unartuarssuk
Palaeanthus tenuistriatus					×	
Ginkgoites pluripartita	×					
G. concinna	×					
Sequoiites concinna					×	Ujaragsugssuk
Elatocladus Smittiana	×					
Cyparissidium gracile	×			×		
Protophyllocladus subintegrifolius	×					
P. polymorphus	×					
Phyllites borealis	×					
Magnoliaephyllum Thomsenianum	×					
M. Newberryi	×					
Magnoliaestrobus Gilmouri						Kardlok
Menispermites Nordenskiöldi	×					

[1] HEER (83); SEWARD (26); GRØNLAND (21), maps VIII, IX.

	Atanikerdluk (Atane)	Patut (Patoot)	Kuk (Kome)	Upernivik I (Atane)	Igdlokunguak (Atane)	Other localities
Leptospermites arcticus	×					
Myrtophyllum sp.						Amisut
Bauhinites groenlandica	×					
Dalbergites simplex	×				×	
D. borealis	×					
Platanus Newberryana		×				
Platanophyllum insigne	×				×	Kardlok
Sapindopsis angusta	×					
Dicotylophyllum ovale	×					
Cinnamomoides sp.		×				
Dicotylophyllum Shottoni	×					
Planta incertae sedis	×				×	

Lack of precise knowledge of the position of some of the localities and of the stratigraphical relations of the various beds precludes any authoritative classification of the Greenland plants on a satisfactory geological basis. A careful revision of the stratigraphical relations of the plant-bearing strata and of the species they contain, would be of great value, and the necessary work would not be very difficult. The strata containing plant remains probably represent a considerable length of time ranging from the early stages of the Cretaceous period to at least the upper part of the Eocene. As one of us wrote nine years ago[1] — »In the Cretaceous floras of Greenland, Dicotyledons, which are surprisingly modern in the form of the leaves, occur in association with Ferns and Gymnosperms which in other parts of the world are characteristic of floras distinguished by an absence of any recognizable examples of modern Angiosperms. This fact lends support to the view that it was within the Arctic Circle that the evolution of deciduous Angiosperms progressed with greater rapidity and energy than in more southern latitudes.»

The Alaskan floras described by the late ARTHUR HOLLICK[2] from localities a few degrees south of the Arctic Circle have many members common to the Cretaceous floras of Greenland. There are two horizons of plant-bearing beds; those of the Yukon Valley correlated, approximately, with the Dakota sandstone, and those of the Alaskan Peninsula, assigned to a slightly higher horizon and compared with the Montana Formation. Both floras were believed by HOLLICK to be Upper Cretaceous, an estimate supported by evidence furnished by marine faunas. HOLLICK drew attention to certain features of great interest, namely the occurrence of such Jurassic plants as *Podozamites*

[1] SEWARD (26), p. 155.

[2] HOLLICK (30).

lanceolatus, *Ginkgo digitata* and *G. concinna*, species of *Nilssonia*, etc. Several of the Alaskan Ferns, Conifers, and Dicotyledons are Greenland species: both floras, the Alaskan and the Greenland, furnish striking evidence of an admixture of comparatively modern flowering plants and more archaic types of Ferns and Gymnosperms. The partial agreement between these Arctic and sub-Arctic floras with temperate Upper Cretaceous floras provides a reason for referring them to an Upper Cretaceous age: we prefer to think of the botanical similarity not as proof of contemporaneity, but as indicative of an earlier development of certain Angiosperms in the Arctic botanical province. The plant-beds of Atanikerdluk, Upernivik Island, Igdlokunguak, with some of the beds at Patut, contain samples of a flora in which Jurassic-Wealden and Cenomanian types are intermingled. We are inclined to think that this flora flourished in Arctic lands in the early stages of the Cretaceous period and before the related floras became established in more southern latitudes. We believe that the Arctic and sub-Arctic floras favour the old view of a southward migration from polar regions.

In this connexion it is interesting to find connecting links between the Cretaceous flora of western Greenland and the Rhaetic-Liassic flora from the eastern side. The extremely thorough examination of the Rhaetic-Lias eastern floras by Professor HARRIS[1] has furnished a remarkable picture of an Arctic vegetation comparable in richness and in vigour with the contemporary flora of southern Sweden. Among the Ferns, *Laccopteris*, *Gleichenites*, *Hausmannia*, and *Cladophlebis* are common to both the Rhaetic eastern and the Cretaceous western floras; *Pterophyllum*, *Pseudoctenis*, *Ptilophyllum*, and possibly Bennettitalean flowers among the Cycadophyta; *Baiera* and *Ginkgoites* as representatives of the Ginkgoales. It is perhaps worth pointing out that the leaves named by HARRIS *Furcula granulifer*[2], and regarded by him as possibly Angiospermous, have a venation not unlike that of our *Myrtophyllum*. We know nothing of the vegetation of Greenland in the interval separating in time the eastern and western floras, but we can imagine a gradual development of new species of the older Jurassic genera and the apparently rapid evolution of Angiosperms.

When comparison is made of the Greenland Cretaceous flora and the Cretaceous and Tertiary floras of North America and Europe evidence of a southward migration seems to be clearly established. We find many Angiosperms in floras of more southern regions which are either specifically identical with or closely allied to species of wide geographical distribution in middle Cretaceous and early Tertiary floras. As we have already said, the Greenland flora has a much more decided Lower Cretaceous and Jurassic facies. This southward migration may be followed still further if we seek the present homes of flowering plants which appear to be most closely related to some of the extinct Arctic species. This is also illustrated by such Ferns as *Gleichenia*, *Matonia* (cf. *Laccopteris*) and *Dipteris* (cf. *Hausmannia*).

[1] HARRIS (26)—(35).

[2] HARRIS (32), p. 4.

The Lower Cretaceous (Wealden) affinities are illustrated by *Laccopteris*, *Hausmannia*, and *Sphenopteris* (*Onychiopsis*) *psilotoides*; *Pseudocycas* and other Cycadophytes; and by *Ginkgoites* and *Baiera*.

The Conifers are too imperfectly known to be used as trustworthy evidence: some are practically indistinguishable from Lower Cretaceous and Jurassic types while others supply connecting links between Cretaceous, Tertiary, and recent floras.

There is one other reflection suggested by a comparison of Jurassic, Cretaceous, and Tertiary floras in Arctic and Temperate regions: the older elements in the Cretaceous floras, derived from Jurassic ancestors, give the impression of persistent types which at the peak of their development and in the prime of their vigour were almost cosmopolitan and occupied territory in practically all parts of the world. They do not as a whole afford definite evidence of the existence of well-marked botanical provinces. Eventually these types died out or some lingered on through the ages in tropical and subtropical refuges. If, on the other hand, we compare the early Tertiary floras of the northern hemisphere, we find a close similarity between circumpolar floras and others in temperate regions, e. g. the flora of the Island of Mull (Scotland): we notice also a striking difference between these more nothern floras and those of the same geological age in southern England and central Europe; botanical provinces have become clearly differentiated.

There is much to be done before we can hope to unravel the problems of phytogeography: the palaeobotanical data throw a flood of light on the wanderings of plants over the world's surface; they also raise many problems such as the ever-present question of climatic change as well as the various factors which have conditioned evolution, and the rise and fall of genera and families, during the course of geological history.

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Explanation of Plates.

(The specimens are in the Swedish Museum of Natural History, Stockholm, except those marked **K**, which are in the Mineralogical and Geological Museum, Copenhagen.)

Plate I.

Fig. 1. *Equisetites* sp. (Tuber). ×2. K.
» 2. » (Diaphragm). ×3. K.
» 3. *Laccopteris latifolia* (NATH.). ×4.
» 4. *Equisetites amissus* HEER. ×4. K.
» 5. *Gleichenites Porsildi* SEW. ×4.
» 6. *G. Nordenskiöldi* HEER. Nat. size.
» 7. *Hausmannia Dicksoni* (HEER). Nat. size. K.
» 8. *Gleichenites Nordenskiöldi* HEER. ×4.

Plate II.

Fig. 9. *Gleichenites Gieseckiana* (HEER). Nat. size. K.
» 10. *Equisetites amissus* HEER. Nat. size. K.
» 11. *Pterophyllum Harrisi* sp. nov. ×1 1/2. K.

Plate III.

Fig. 12. *Pterophyllum Harrisi* sp. nov. ×1 1/2. K.
» 13. *Pseudocycas Thomasi* sp. nov. *Ca.* ×2. K.
» 14. *Pseudoctenis latipennis* (HEER). ×1 1/2. K.
15. *Pterophyllum Harrisi* sp. nov. ×1 1/2. K.
16. *Pseudocycas Thomasi* sp. nov. Very slightly enlarged. K.

Plate IV.

Fig. 17. *Sphenopteris groenlandica* (HEER) *ex parte*. Nat. size. K.
» 18. *Sequoiites concinna* HEER. Nat. size. K.
» 19. *Cyparissidium gracile* HEER. Nat. size. K.
» 20. *Magnoliaestrobus Gilmouri* gen. et sp. nov. Nat. size. K.
» 21. *Sequoiites concinna* HEER. Nat. size.
» 22. *Elatocladus Smittiana* (HEER). Nat. size.

Plate V.

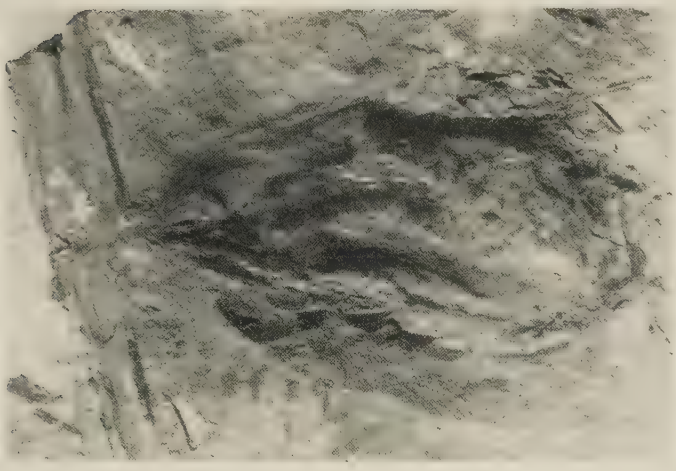
Fig. 23. *Leptospermites arcticus* sp. nov. ×5.
» 24. *Sapindopsis angusta* (HEER). Nat. size. K.
» 25. *Dicotylophyllum Shottoni* sp. nov. Very slightly enlarged.
» 26. *Palaeanthus tenuistriatus* sp. nov. ×1 1/2.
» 27. *Leptospermites arcticus* sp. nov. ×5.
» 28. *Myrtophyllum boreale* sp. nov. ×1 1/2. K.

Plate VI.

Fig. 29. *Leptospermites arcticus*. ×1 1/2.
» 30. *Protophyllocladus subintegrifolius*. Nat. size.
» 31. *Platanus* fruits. Nat. size. K.
» 32. *Protophyllocladus polymorphus*. Nat. size.
» 33. Fruits of *Magnolia tripetala*. Nat. size.
» 34. *Platanus* sp. Nat. size. K.

Tryckt den 31 december 1935.

Uppsala 1935. Almqvist & Wiksells Boktryckeri-A.-B.



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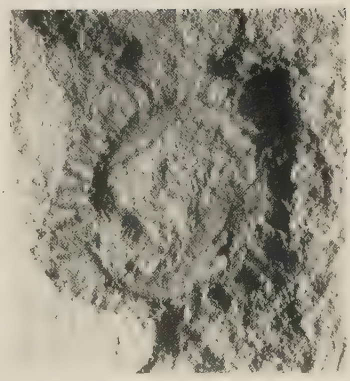

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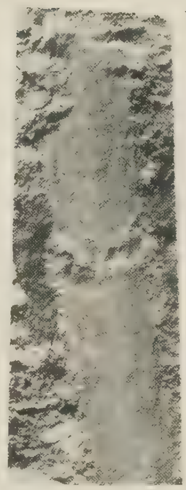

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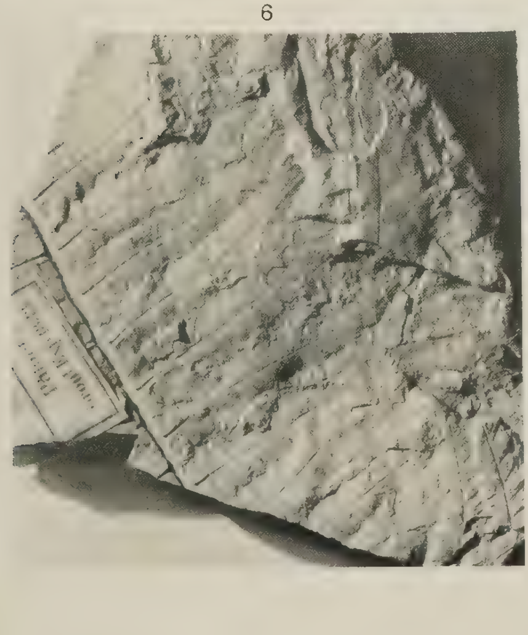

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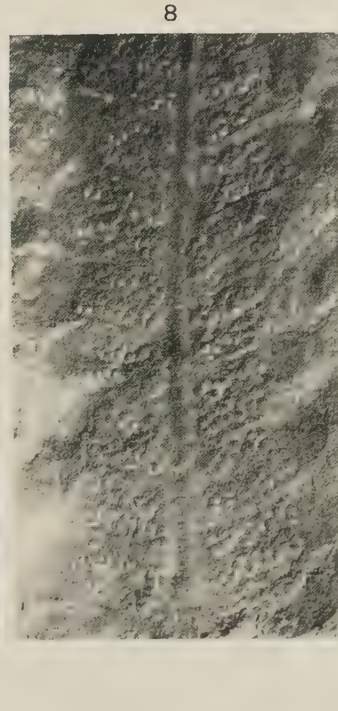

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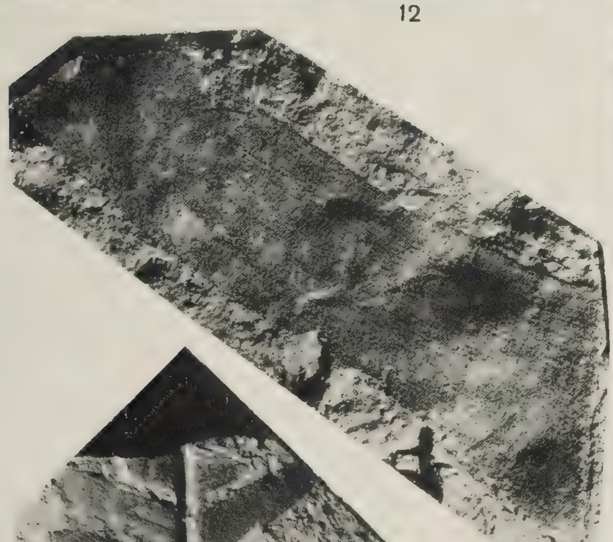

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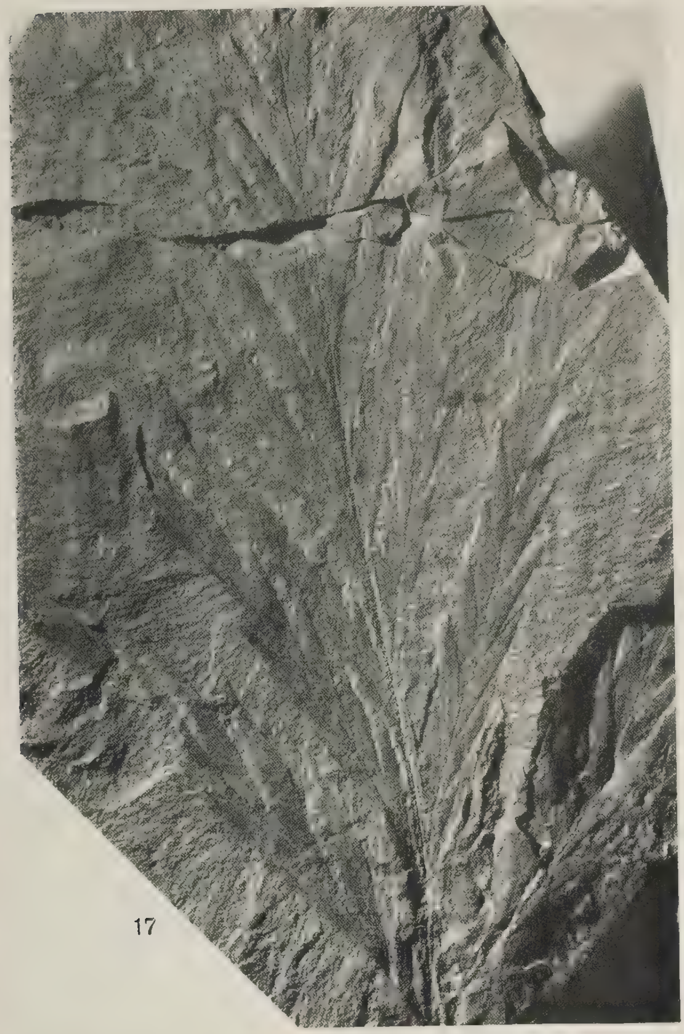

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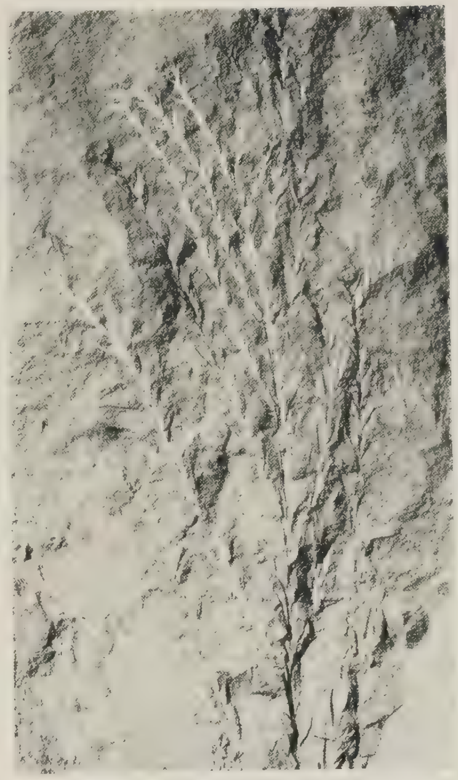

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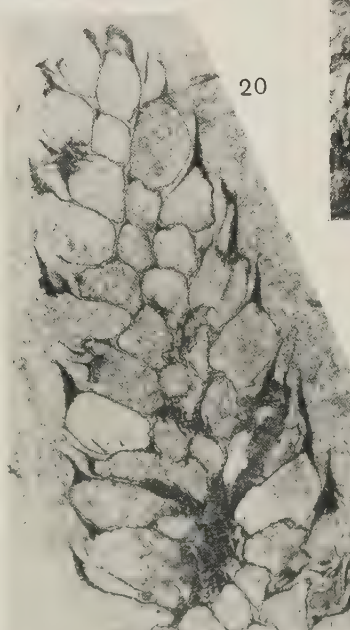

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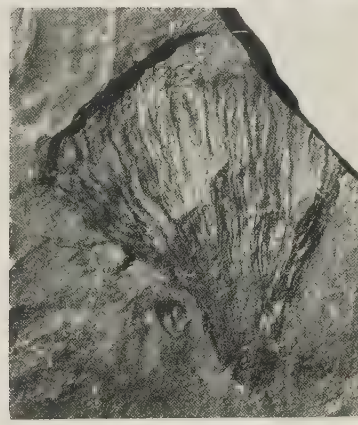

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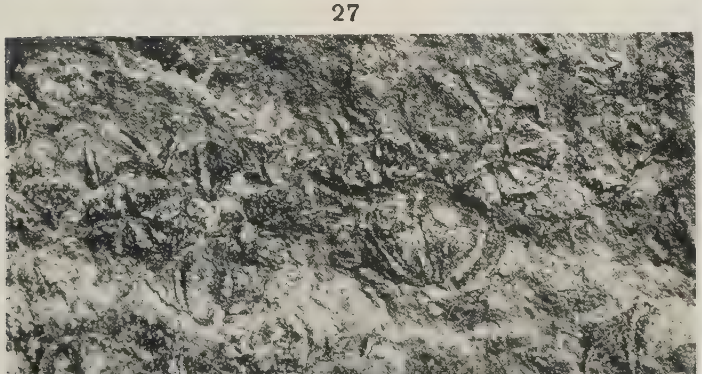

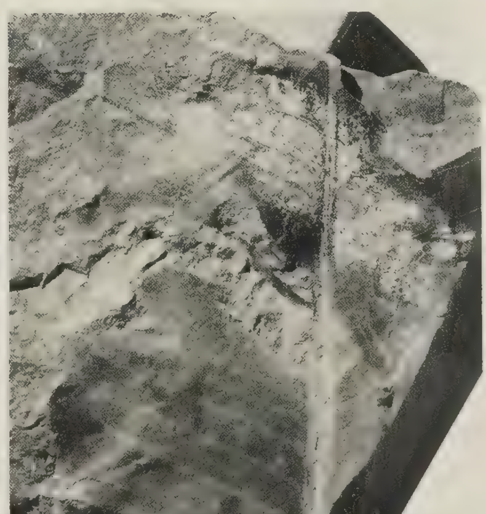

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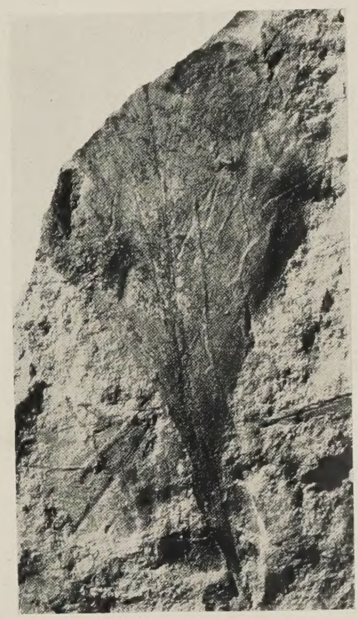

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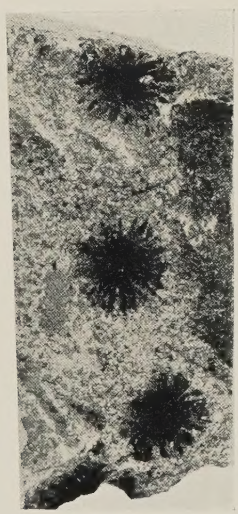

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